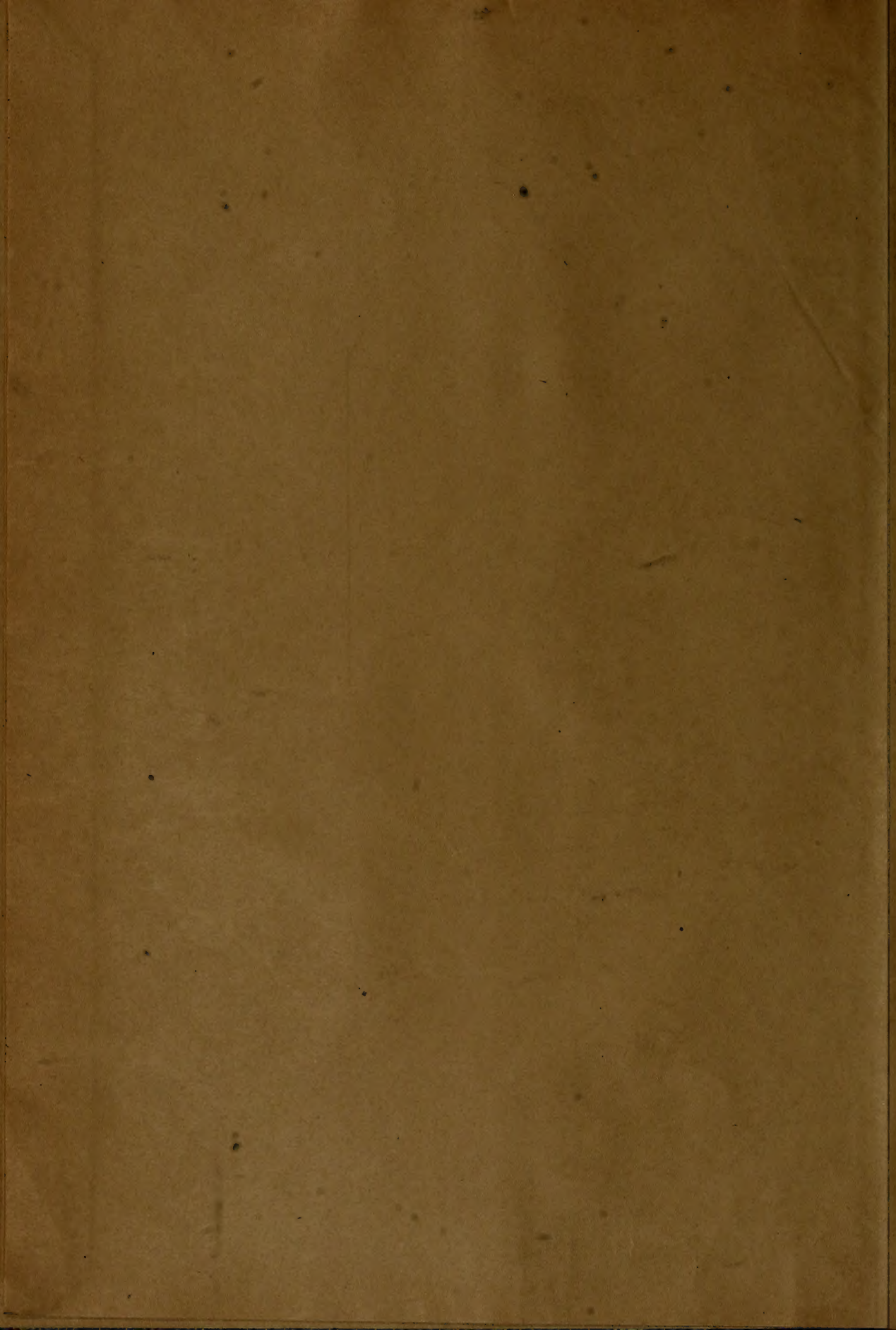




Accession No. 42480

Call No. qc 622.05 M6
v. 170
1950



Index to Volume 120, Mining and Scientific Press,

JANUARY TO JUNE, 1920

A		Page	Page
A B C of iron and steel, new book	A. O. Backert	435	
Accidents caused by missed holes		277	
In metallurgical plants		574	
Accounting at metal mines	A. T. Parsons	804	
Advice to students	R. H. Stretch	629	
Alaska, future of interior		595	
Labor conditions in		847	
Metal production during 1919		273	
Alaska Gold Mines Co., company report		512	
Alaska Juneau Gold Mining Co., company report		815	
Electrical equipment	F. Seward Rice	251	
Aldrich Pump Co.		733	
Allen, A. W., Handbook of ore dressing, new book		696	
Allen, C. A., and Dr. A. L. Murray	Physical examination for hoisting engineers	421	
Allis-Chalmers Mfg. Co.	Gasoline-engine driven generator sets	361	
Alta, snowslides at		580	
American Cyanamid Co.		513	
A. I. M. & M. E. meeting	Editorial	402	
Meeting at Ajo		93	
American Mining Congress		206	
American mining engineers abroad	Editorial	854	
American Zinc, Lead & Smelting Co., company report		623	
Anaconda Copper Mining Co.		887	
Analysis of magnesite	W. C. Riddell	943	
Of minerals and ores of rarer elements, new book			
W. R. Schoeller and A. R. Powell		69	
Anderson, Robert Hay, obituary		246	
Andros, Stephen O., Petroleum handbook, new book		69	
Anemometers for air	Walter S. Weeks	895	
Anniversary, our sixtieth	Editorial	737	
Ditto	Edgar Hall	783	
Antimony and its uses		299	
Mining in United States		201	
Apex litigation at Bunker Hill	T. A. Rickard	791	
Argall, Philip	De-gassing cyanide solutions	219	
Arizona metal production during 1919		276	
Oldest copper mine	F. Le Roi Thurmond	647	
Arnold, Ralph	Letter from Herbert Hoover	423	
Asbestos, a Canadian specialty	F. C. C. Lynch	531	
Ashio smelter in Japan			
Ritaro Hirota and Kyoshi Shiga		224	
A. S. & R. Co. and Bunker Hill company			
T. A. Rickard		795	
Assay maps	Wm. Huff Wagner	453	
Of platinum	C. W. Davis	823	
Assaying, volatilization in	Frederic P. Dewey	458	
Astor, John Jacob	T. A. Rickard	6	
Atascadero	Editorial	294	
Aulbach, Adam	T. A. Rickard	189	
Austin, L. S.	Electrolytic zinc plant of Judge M. & S. Co.	409	
Austin, W. L.	T. A. Rickard	116	
Ditto	Complex ores in California	786	
Australia, mining industry in	F. H. Bathurst	158	
B			
B. & A. Mining Co. near Gilham, Arkansas		95	
Babbitt, Kurnal R., obituary		212	
Backert, A. O.	A B C of iron and steel, new book	435	
Baker, Ray Stannard	New industrial unrest, new book	886	
Ball-mills, fine grinding in	Henry Hanson	17	
Operation	Editorial	363	
Practice	Paul T. Bruhl	333	
Practice, some ideas on	Curtis Lindley, Jr.	221	
Bancroft, George J.	Blue-sky laws	333	
Bard, Darsie C., obituary		212	
Barnes-King Development Co., company report		553	
Barreno mine	S. J. Lewis	443	
Barrett, Edward P., and John C. Morgan	Chemical laboratory	300	
Bathurst, F. H.	Mining industry in Australia	158	
Beckett, P. G., reports on Phelps Dodge operations		57	
Beckman, J. W.	Complex ores in California	788	
Bell, J. Mackintosh	Spassky and Atbasar copper mines in Siberia	765, 825	
Bellows, E. C.	Editorial	182	
Benguet Consolidated	C. M. Eye	479	
Betts, Harold S.	Timber: Its strength, seasoning, and grading, new book	554	
Billingsley, Paul	Some features of geological department of A. C. M. Co.	907	
Bingham Mines Co., company report		512	
Bishop, James A.	Distillation of shale-oil	371	
Bismuth, magnetic separation of			
Wm. E. Hitchcock and J. R. Pound		379	
Black Butte ore, flotation of			
E. G. Stowell and Will H. Coghill		117	
Blacksmith and good drill bits	D. E. Dunn	817	
Blackwood, Charles Keith, obituary		30	
Blandford, Thomas	Concrete mine-bulkhead	536	
Blasting accidents from missed holes		277	
Blue-sky laws		204	
Ditto	George J. Bancroft	323	
Ditto	Editorial	34, 181	
Bolshevism in Russia	R. G. Knickerbocker	677	
Bonus system of Phelps Dodge Corporation		127	
Books as tools	E. A. Goeway	852	
Borzynski, F.	Como Consolidated mill	55	
Ditto, Operation of Case oil-fired assay-furnace		713	
Bourne, F. J.	Prohibition	76, 297	
Bowl-classifier, Dorr	Henry Hanson	905	
Boyle, Emmet D.	Editorial	560	
Bradley, Bruff & Labarthe		253	
Branner, John Caspar	Outlines of the geology of Brazil, new book	435	
Brinsmade, R. B.	Mining and smelting near Matehuala, Mexico	85	
Ditto	Patents and progress	335	
British Columbia metal production		242	
Broadbridge, Walter	Editorial	295	
Broken Hill, froth-flotation at	C. C. Freeman	833	
Bruhl, Paul T.	Ball-mill practice	333	
Budget for the Government	Editorial	33	
Buffalo Mines, Ltd., company report		289	
Bullion, discrepancies in weighing			
Harry R. S. Wilkes		454	
Bunker Hill & Sullivan M. & C. Co., company report		885	
Bunker Hill enterprise	Editorial	255	
Ditto	Edgar Hall	857	
Ditto	T. A. Rickard	5, 41, 109, 185, 261, 337, 485, 525, 703, 791	
Tramway	William Hewitt	931	
Bureau of Mines	Editorial	36	
Director	Editorial	666	
Burghardt, Henry D.	Lathe, bench-work, and work at the forge, new book	624	
Burlingame, Walter E.	Precious metals in oil-shale	668	
Burma mine	W. Shellshear	39	
Butte, I. W. W. activity at	Editorial	779	
Miners strike		652	
Strike at	Editorial	628	
Butte & Superior Mining Co., company report		511, 885	
V. Minerals Separation	Editorial	180	
By-product coke-ovens of the Granby Consolidated			
W. A. Williams		600	
C			
Cadmium in the United States		714	
Calculation of furnace charges	O. E. Jager	195	
California metal production in 1919			
Charles G. Yale		91	
Calkins, F. C.	T. A. Rickard	262	
Calumet & Arizona company	Editorial	216	
Camp Bird, Ltd., company report		250	
Campbell, Andrew	Petroleum refining, new book	177	
Canada, mineral production during 1919			
J. McLeish		571	
Canadian metal production during 1919		100	
Canadian Mining Institute		467	
Car dumper description		473	
Loading grating	Wm. S. Evans	534	

	Page		Page
Carpenter, E. E. Operations of Nevada Wonder Co. during the War	537	Company reports, cont.	
Carson Hill Co. progress	547	Old Dominion Co.	623
Cascade boxes for flotation C. C. Freeman	537	Portland Gold Mining Co.	511
Case oil-fired assay-furnace F. Borzynski	713	Ray Consolidated Copper Co. 289, 511,	732
Ditto J. Claire Evans	931	Santa Gertrudis Co.	250
Ditto P. L. Guppy	857	Shattuck Arizona Copper Co.	623
Ditto M. J. Sherlock	823	Silver King Consolidated Mining Co.	815
Caunt, G. W., and Henry Louis Traverse tables, new book	624	Superior & Boston Copper Co.	289
Centrifugal fan, theory of Walter S. Weeks	858	Teek Hughes Gold Mines, Ltd.	512
Chafin, C. E. Mine and flotation-plant of American Graphite Co.	567	Tefiskaming Mining Co., Ltd.	511
Chamberlain, Zear J., obituary	508	Tomboy Gold Mines Co.	250
Chapman, Robert Hollister, obituary	174	Tonopah-Belmont Development Co.	885
Chapter in journalism T. A. Rickard	745	Tonopah Eastern Mining Co.	885
Chemical laboratory John C. Morgan and Edward P. Barrett	300	Tonopah Extension Mining Co.	885
Chief Consolidated Mining Co., company report 289, 844		United Verde Extension Mining Co.	553
Chile-American Association Mining Scholarship Editorial	516	Utah Consolidated Mining Co.	623
Chile Copper Co., company report	289	Victoria Copper Mining Co.	512
Chino Copper Co., company report	687, 843	Vindicator Consolidated Gold Mining Co.	511
Chloride roasting and leaching at plant of the Tintic Milling Co. Theodore P. Holt	603	Yukon Gold Co.	623
Chloridizing processes Stuart Croasdale	259	Como Consolidated mill F. Borzynski	55
Ditto Harai R. Layng	77, 520	Complete practical machinist, new book Joshua Rose	435
Christy, John, obituary	728	Complex ores in California W. L. Austin	786
Chromite, future in the United States Samuel H. Dolbear	645	Ditto J. W. Beckman	788
Production in 1919	718	Ditto Editorial	593
Clawson, Selden I. Chloridizing processes	79	Ditto A. H. Heller	783
Climax Molybdenum Co.	513	Concentrating at Bunker Hill T. A. Rickard	525
Climbing hills at Pachuca	818	Concerning gold Editorial	822
Coal mining Editorial	558	Metal quotations Editorial	331
Problem Editorial	401	Concrete mine-bulkhead Thomas Blandford	536
Production in India	496	Coniagas Mines, Ltd., company report	289
Coeur d'Alene, discovery of gold T. A. Rickard	42	Consolidated Interstate Callahan Mining Co., company report	732
Coghill, Will H., and E. G. Stowell Experimental flotation of low-grade quicksilver ore	117	Consortium for China E. Hedburg	923
Coke industry during 1919	873	Contract system in mines	667
Coking plant of the Granby Consolidated W. A. Williams	600	Wage system for miners A. K. Knickerbocker	497
Colbath, James S. Crowe process	38	Contribution to study of flotation H. L. Sulman	14, 47, 122
Colburn, Jr., E. A. Mining in narrow stopes	715	Converter practice O. E. Jager	198
Colby, William E. Geological experts in the courts	930	Copper and copperas George O. Deshler	788
Collapse of silver Editorial	890	Exports Editorial	735
Color bar Editorial	440	Production	657
Colorado metal production during 1919	163	Production in Michigan	24
Combination method of mine-sampling Fred H. Dakin	519	Production in United States during 1919	202
Ditto S. F. Shaw	630	Refinery in Russia R. G. Knickerbocker	677
Ditto Morton Webber	303	Stocks Editorial	515
Comet smelter F. Le Roi Thurmond	647	Corcoran, Ray A., obituary	358
Commonwealth Club on engineering activities	717	Corporation and the individual P. B. McDonald	701
Company reports:		Cortez mine to be re-opened	803
Alaska Gold Mines Co.	512	Cost of opening Seneca mine	279
Alaska Juneau Gold Mining Co.	815	Plus method, Westinghouse, Church, Kerr & Co.	556
American Zinc, Lead & Smelting Co.	623	Cottrell, Frederick G. Editorial	697
Barnes-King Development Co.	553	Cottrell process in Japan	
Bingham Mines Co.	512	Ritaro Hirota and Kyoshi Shiga	223
Buffalo Mines, Ltd.	289	Coudert, Frederick R., letter from Herbert Hoover	423
Bunker Hill & Sullivan M. & C. Co.	885	Course for practical miners	719
Butte & Superior Mining Co.	511, 885	Courts, geologists in Editorial	593
Camp Bird, Ltd.	250	Crawford, E. P. Silver	37
Chief Consolidated Mining Co.	289	Cripple Creek, exploration at	876
Chile Copper Co.	289	Production at	58
Coniagas Mines, Ltd.	289	Croasdale, Stuart Chloridizing processes	77, 259
Consolidated Interstate Mining Co.	732	Croghan, E. H., and F. Wartenweiler Neutralizing mine-waters on the Rand	376
Daly West Mining Co.	553	Cross, Daniel Public service and private practice	183
Davis-Daly Copper Co.	511	Crossings, some notes on H. C. Hoover	743
El Oro Mining & Railway Co.	250	Crowe process James S. Colbath	38
Franklin Mining Co.	695	Ditto N. S. Keith	220
Goldfield Consolidated Mines Co.	553	Crushing and concentrating at Bunker Hill T. A. Rickard	485
Hecla Mining Co.	553	Custodian of enemy property in South Africa Editorial	440
Hollinger Consolidated Gold Mines, Ltd.	512	Cutler-Hammer Mfg. Co.	70, 734
Inspiration Consolidated Copper Co.	695	Mine-locomotive charging-panel	438
Jim Butler Tonopah Mining Co.	623	Cyanidation at Como Consolidated mill F. Borzynski	55
Lake Shore Mines, Ltd.	511	Cyanide, aero brand	513
La Rose Mines, Ltd.	695		
Mass Consolidated Mining Co.	553		
Miami Copper Co.	815		
Mining Corporation of Canada	815		
Natomas Company of California	512		
Nevada Consolidated Copper Co.	289, 512		
New Idria Quicksilver Mining Co.	695		
Nipissing Mines Co.	815		

D

Dakin, Fred H. Combination method of mine-sampling	519
Daly West Mining Co., company report	553
Development at	504
Davis, C. W. Assay of platinum	823
Davis, E. W. Fine grinding in ball-mills	18
Davis-Daly Copper Co., company report	511
Davy, W. Myron, and C. Mason Farnham Microscopic examination of the ore minerals, new book	624
Day after Editorial	698
De-gassing cyanide solutions Philip Argall	219

	Page		Page
De Kalb, Courtenay. Review of 'Technical Writing'.....	816	Editorial, cont.	
Denver Fire Clay Co.....	400	Mysore Gold Mining Co.....	2
Denver Rock Drill Mfg. Co.....	733	Nomination of Hoover.....	265
Deshler, George O.....Copper and copperas.....	788	Our motto.....	734
Detonating dynamite.....	278	Our sixtieth anniversary.....	737
Detonators, electric.....		Preface.....	738
Carl T. Long and Hubert L. Pascoe.....	902	Premium on gold.....	365
Development of rock-drill in America.....		Prohibition.....	107
C. A. Hirschberg.....	139	Prospects in Mexico.....	855
Dewey, Frederic P.....Volatilization in assaying.....	458	Public office and private practice.....	35, 73
Diamond mining in Africa.....	939	Railroads.....	257
Digging, more needed.....J. H. Farrell.....	272	Report of the Industrial Conference.....	477
Director U. S. Bureau of Mines.....Editorial.....	666	Resignations from U. S. Geological Survey.....	1
Discovery a pre-requisite to mining claim.....		Revolt of Sonora.....	592
Editorial.....	475	Seattle convention.....	559
Discrepancies in weighing bullion.....		Spillsbury, E. Gribbon.....	854
Harry R. S. Wilkes.....	454	Strategy of minerals.....	780
Distillation of shale-oil.....James A. Bishop.....	371	Strike at Butte.....	628
Distinction and a moral.....Editorial.....	781	Sulman and Minerals Separation.....	891
Dividends from North American mines.....249, 731		Supply of oil.....	890
Dixon Crucible Co., Joseph, annealing.....	438	System in mining.....	108
Dolores mine.....R. B. Brinsmade.....	87	Thawing frozen ground with cold water.....	364
Dolly Varden.....Editorial.....	627	To young engineers.....	559
Mine, the story of.....A. J. T. Taylor.....	631	War Minerals Relief.....	666
Dolbear, Samuel H.....Future of chromite in		Who's Hoover?.....	476
the United States.....	645	What the miners think.....	699
Donaldson, Melvin S.....Initial velocity of bubbles in a		Electric furnaces in the iron and steel industry, new	
pneumatic flotation-cell.....	940	book.....W. Rodenhauer,	
Dorr bowl-classifier.....Henry Hanson.....	905	J. Schoenawa, and C. H. Vom Baur.....	624
Douglas, James S.....T. A. Rickard.....	673	Precipitation in Japan.....	
Drayer, C. E.....Engineering Employment Bureaus.....	220	Ritaro Hirota and Kyoshi Shiga.....	223
Dredging in Alaska.....	299	Electrical equipment at Alaska Juneau.....	
Operations near Murray, Idaho.....T. A. Rickard.....	189	F. Seward Rice.....	251
Drill-steel furnace, Sullivan Machinery Co.....	555	Precipitation of silver refinery fumes.....	589
Dry placer plant in Oregon.....	240	Electrolytic zinc smelting by Judge M. & S. Co.....	
Dues to A. I. M. & M. E.....Editorial.....	71	L. S. Austin.....	409
Dunn, D. E.....Blacksmith and good drill bits.....	817	Elements of refrigeration, new book.....	
Duplex four-wheel drive truck.....	818	Arthur M. Greene, Jr.....	290
Dynamite, detonating of.....	278	Of smelting-plant design.....O. E. Jager.....153, 195,	
		El Oro, geology at.....S. J. Lewis.....	935
		El Oro Mining & Railway Co., company report.....	250
		Emmons, S. F.....Editorial.....	927
		Employment psychology, new book.....Henry C. Link.....	554
		Empire Copper Co., operations of.....	168
		Employees Benefit Association at Bisbee.....	237
		Employment Bureaus.....C. E. Drayer.....	220
		Engineering activities of universities and government	
		bureaus.....	717
		Ditto.....A. B. Parsons.....	824
		Foundation seeks endowments.....	817
		Engineering and Mining Journal.....T. A. Rickard.....	745
		Engineering Council.....Editorial.....	218
		And registration of engineers.....	232
		Engineering Employment Bureaus.....C. E. Drayer.....	220
		Ditto.....Bradley Stoughton.....	405
		Enos, George M.....Volumetric method for tungsten.....	869
		Entombed in mine.....George Huston.....	53
		Esmeralda mine.....R. B. Brinsmade.....	88
		Ethics, proposed code of.....	901
		Eureka, Nevada.....Editorial.....	145
		Evans, J. Claire.....Case oil-fired assay-furnace.....	931
		Evans, Wm. S.....Car-loading grating.....	534
		Exploration at Bunker Hill mine.....T. A. Rickard.....	337
		For mines.....J. H. Farrell.....	269
		Mining.....Editorial.....	403
		Eye, C. M.....Mining in the Philippines	
		during 1919.....	479
		F	
		Fahrenwald flotation machine, Francis A. Thomson.....	871
		Fair deal.....Edwin Higgins.....	346
		Fair, James G.....T. A. Rickard.....	675
		Fairbanks, Morse & Co.....	254
		Fall in exchange.....Editorial.....	217
		Report on Mexico.....Editorial.....	856
		Farnham, C. Mason, and W. Myron Davy.....Microscopic	
		examination of the ore minerals, new book.....	624
		Farrell, J. H.....Mining exploration.....	269
		Fay, Albert H.....Glossary of the mining	
		and mineral industry, new book.....	696
		Federal Trade Commission, proceedings against Min-	
		erals Separation.....	909
		Federated American Engineering Societies.....	947
		Fellowships in metallurgy, Utah School of Mines.....	620
		Fenner, L. A.....Stock raisers and mineral lands.....	298
		Ferry, D. H.....T. A. Rickard.....	189
		Filing mine reports.....Kirby Thomas.....	701
		Finch, J. K.....Topographic maps and sketch	
		mapping, new book.....	886

E

Earthquake-fire issue reproduction.....	741
Easton, Stanly A.....T. A. Rickard.....	185
Economic history of the Bunker Hill.....	
T. A. Rickard.....	708

Editorial:

American mining engineers abroad.....	854
Blue sky law.....	181
Collapse of silver.....	890
Complex ores in California.....	594
Concerning gold.....	822
Concerning metal quotations.....	331
Day after.....	698
Director U. S. Bureau of Mines.....	666
Distinction and a moral.....	781
Dolly Varden.....	627
Fall in exchange.....	217
Geologists in the Courts.....	593
Geology for miners.....	927
Gold bounty.....	626
Gold production of the world.....	665
Goldfield Consolidated.....	296
Great disillusion.....	441
Greatest gold mine.....	441
Herbert Hoover for President.....	106, 145
Hoover and the Republicans.....	330
Hoover boom.....	180
Hoover campaign.....	404
Hoover for President.....	106, 145
Hoover on national economics.....	3
Hoover will accept nomination.....	517
Human and humane.....	332
Immigration.....	927
Industrial conference.....	34
Industrial relations.....	517
International mining convention.....	699
Intervention in Mexico.....	146
Jennings, Hennen.....	364
Kauri gum.....	105
Leasing act.....	295
Let us have peace.....	4
Licensing of engineers.....	217
Medal for Mr. Sulman.....	256
Mexican melodrama.....	821
Minerals Separation under scrutiny.....	698
Mining exploration.....	403
Money for Europe.....	74
Moralities of journalism.....	665

	Page		Page
I			
Idaho, history of	T. A. Rickard..... 41	Let us have peace	Editorial..... 4
Metal production during 1919.....	164	Lewis, E. G.	Editorial..... 294
School of Mines	811	Lewis, S. J.	Editorial..... 927
School of Mines, flotation discussion at.....	459	Ditto.....	Ore deposits of Mexico..... 412, 443, 933
Immigration	Editorial..... 927	Liberty bonds	193, 777
Imprisoned underground	George Huston..... 53	Licensing of engineers	Editorial..... 217
Improved mine-locomotive	851	Life insurance at Tonopah.....	Editorial..... 363
Wedge for deflecting diamond-drills.....	C. Erb Wuensch..... 945	Lindley, Jr., Curtis.....	Some ideas on ball-mill practice..... 221
Incidents in a mining engineer's life.....	E. T. McCarthy..... 561	Link, Henry C. Employment psychology, new book.....	554
India, coal production	496	Link Belt 'lettgo' device.....	888
Indicators	Edgar Hall..... 857	Litigation at Bunker Hill.....	T. A. Rickard..... 791
Industrial Conference	Editorial..... 34	Locke, Augustus.....	Two professions of mining geology..... 161
Ditto.....	H. C. Hoover..... 508	Lockhart, Thomas D.....	T. A. Rickard..... 674
Ditto.....	Observer..... 76	Long, Carl T., and Hubert L. Pascoe.....	Study of electric detonators..... 902
Report of	Editorial..... 477	Lookout mine	618
Relations	Editorial..... 517	Loring, W. J., report of Plymouth Consolidated.....	619
Survey of highways	734	Louis, Henry, and G. W. Caunt.....	Traverse tables, new book..... 624
Ingalls, W. R.....	Editorial..... 144	Lowe, A. H.....	Technical methods of ore analysis, new book..... 69
Ingersoll-Rand Co.....	817	Lynch, F. C. C.....	Asbestos, a Canadian specialty..... 531
Drill-steel sharpener	661	M	
New Jackhammer	399	'M-Z' automatic mine-cars.....	O. J. Zook..... 932
Initial velocity of bubbles in pneumatic flotation-cell.....	Melvin S. Donaldson..... 940	MacArthur, John S., obituary	692
Inspiration Consolidated Copper Co., company report.....	695	Macer, L. W.....	Hanging-wall support on the Rand..... 539
Interesting experiment	Charles W. Gardner..... 929	Mackay, John W.....	T. A. Rickard..... 675
Interfacial tension in flotation.....	H. L. Sulman..... 124	MacLaurin, Richard Cockburn, obituary.....	174
International Mining Convention.....	Editorial..... 699	MacNaughton, James	Editorial..... 559
Intervention in Mexico	Editorial..... 146	Ditto.....	Advice to students..... 570
Iron hunter, new book.....	Chas. S. Osborn..... 290	Magnesia cement to protect mine-timbers.....	W. C. Phalen..... 538
Italian quicksilver industry	424	Magnetic separation in Tasmania	Wm. E. Hitchcock and J. R. Pound..... 379
J			
Jager, O. E.....	Elements of smelting plant design..... 153, 195, 405	Maltby, C. S.....	Future of chromite in the United States..... 702
Jalisco, Mexico, geology of.....	S. J. Lewis..... 449	Manganese industry, reaction in.....	H. A. C. Jenison..... 21
Japan, Cottrell process in	Ritaro Hirota and Kyoshi Shiga..... 223	Production	874
Jargon in technical writing.....	T. A. Rickard..... 640	Manjak	272
Jenisen, H. A. C.....	The reactions of the manganese industry..... 21	Manning, Van. H.....	Editorial..... 666
Jennings, Hennen	Editorial..... 364	Manual of cyanidation, new book.....	E. M. Hamilton..... 624
Obituary	396	Manufacture and uses of alloy steels, new book.....	Henry D. Hibbard..... 554
Jigging at Bunker Hill.....	T. A. Rickard..... 491	Market price of silver drops	883
Jim Butler Tonopah Mining Co., company report.....	623	Mason, F. H.....	Recent metallurgy at Trail..... 863
Journalism, a chapter in.....	T. A. Rickard..... 745	Ditto.....	Smelting iron ores..... 76
Judge M. & S. Co., electrolytic zinc plant.....	L. S. Austin..... 409	Mass Consolidated Mining Co., company report.....	553
K			
Kauri gum	Editorial..... 105	Matehuala, Mexico, mining and smelting.....	R. B. Brinsmade..... 85
Keith, N. S.....	The Crowe process..... 219	Matter of geography	E. Vernon Morgan..... 823
Kellogg, Noah S.....	T. A. Rickard..... 109	McCann Co., H. K., patent office decision.....	399
Kennedy, Edward O., obituary	728	McCarthy, E. T.....	Further incidents in life of a mining engineer, new book..... 177
Keynes, J. M.....	Editorial..... 441	Ditto.....	Incidents in a mining engineer's life..... 561
King, S. B.....	Free trips to Sullivan plants..... 662	McChrystal, John H., obituary	212
Kissock, Alan.....	Molybdenum and molybdenum-steel..... 184	McDonald, F. E., obituary	812
Knickerbocker, A. K.....	Contract wage-system for miners..... 497	McDonald, P. B.....	Mr. MacNaughton's advice to students..... 570
Ditto.....	Editorial..... 518	Ditto.....	The corporation and the individual..... 701
Knickerbocker, R. G.....	Russian copper refinery under Bolshevik control..... 677	Ditto.....	Technical Writing..... 857
Kyshtim copper refinery.....	R. G. Knickerbocker..... 677	McFadden bill	Editorial..... 626
L			
Labor shortage in Michigan copper mines.....	685	Mead, Daniel W.....	Hydrology, new book..... 554
Troubles at Tonopah and Divide.....	280	Measurement of ventilating air.....	Walter S. Weeks..... 895
Unrest in South Africa.....	157	Mechanical drafting manual, new book.....	Charles B. Howe..... 886
Lake Shore Mines, Ltd., company report.....	511	Drawing, new book.....	John S. Reid..... 290
Lancaster, William, obituary	882	World year book, new book.....	624
La Paz mill	R. B. Brinsmade..... 85	Medal for Mr. Sulman	Editorial..... 256
La Rose Mines, Ltd., company report.....	695	Metal exchange in Australia.....	F. H. Bathurst..... 158
Lathe, bench-work, and work at the force, new book.....	Henry D. Burghardt..... 624	Quotations, concerning	Editorial..... 331
Layng, Harai R.....	Chloridizing processes..... 77, 520	Metallurgical operations, formulas for determining ton-nages in	A. H. Heller..... 575
Lead concentration at Bunker Hill.....	T. A. Rickard..... 525	Plants, accidents in	574
Deposits in South Africa	714	Metallurgy of complex low-grade ores.....	C. S. Vadner..... 519
Production in United States during 1919.....	202	Of zinc ore at Trail.....	F. H. Mason..... 863
Smelting at Matehuala, Mexico	R. B. Brinsmade..... 85	Metric system	256
Leadville, activity at	578	Mexican melodrama	Editorial..... 821
Production during 1919	129	Mexico, intervention in	Editorial..... 146
Leadville Mines Co. operations.....	723	Ore deposits in	S. J. Lewis..... 412, 443
Leasing Act	Editorial..... 295	Stable government for	148
Legislation regarding railroads.....	Editorial..... 528	Miami Copper Co., company report.....	815
Leschen & Sons Rope Co., A., wire rope stretch.....	438	Microscopic examination of the ore minerals, new book.....	W. Myron Davy and C. Mason Farnham..... 624

	Page		Page
Production of gold and silver in United States during 1919	101	Seattle convention	Editorial... 659
Of manganese	874	Secondary metals	650
Prohibition	F. J. Bourne... 76, 297	Senate hearings on coal industry	729
Ditto	Editorial... 107	Seneca development	462
Prospecting for oil and gas, new book	L. S. Panylty... 554	Mine, cost of opening	279
Prospector	Jack Mulholland... 770	Shaft sinking record	733
Prospectors field book and guide, new book	H. S. Osborn and M. W. von Bernewitz... 886	Shale-oil, distillation of	James A. Bishop... 371
Prospectors Protective Association for British Columbia	99	Shall Americans go abroad to mine?	H. Foster Bain... 761
Prospects in Mexico	Editorial... 855	Shattuck-Arizona Copper Co., company report	623, 913
Protest	Frank H. Probert... 701	Shaw, S. F., Combination method of mine-sampling	630
Public service and private practice	Daniel Cross... 183	Sheldon, G. L., Combination method of mine-sampling	408
Ditto	Editorial... 35, 73	Shellshear, W.,	Burma mine... 39
Ditto	Lester S. Grant... 260	Sherlock, M. J.,	Case oil-fired assay-furnace... 823
'Pulmore' pulley tread	962	Shiga, Kyoshi, and Ritaro Hirota,	Cottrell process... 223
		in Japan	223
		Shockley, W. H.,	Gold in north-eastern Siberia... 931
		Ditto	Simplified spelling... 40
		Shortage of miners in Utah	544
		Siberia, copper mines in	J. Mackintosh Bell... 765
		Spassky and Atbasar copper mines	J. Mackintosh Bell... 825
			E. P. Crawford... 37
		Silver	Editorial... 71
		Coinage	Editorial... 71
		Mining in Nevada	E. E. Carpenter... 537
		Price drops	883
		Silver King Consolidated Mining Co., company report	815
		Simon silver-lead property	464
		Simp spelling	E. M. Hamilton... 147
		Ditto	H. A. Titcomb... 147
		Simplified spelling	W. H. Shockley... 40
		Sixes River district, placer mining in	60
		Skinner, Walter R.,	Mining manual and mining year book, new book... 624
		Small, Harry Haskell, obituary	620
		Smallest mine locomotive	662
		Smelter contracts at Bunker Hill	T. A. Rickard... 797
		Smoke	Editorial... 854
		Smelting cyanide precipitate	870
		Iron ores	F. H. Mason... 76
		Of complex ores	Editorial... 594
		Plant design, elements of	O. E. Jager... 153, 195
		Smith, Grant H.,	First miners and the first civilization... 457
		Smith, Reuben Edward, obituary	66
		Smuggler Union company magazine explosion	388
		Some features of geological department of A. C. M. Co.	Paul Billingsley... 907
			Curtis Lindley, Jr... 221
		Ideas on ball-mill practice	H. C. Hoover... 743
		Notes on crossings	893
		Observations on smelting	Editorial... 592
		Sonora, revolt of	789
		South Africa, milling at New Modderfontein	222
		Panel stopes in	165
		South Dakota, metal production during 1919	J. Mackintosh Bell... 765, 825
		Spassky and Atbasar copper mines in Siberia	Cortez mine to be re-opened... 803
			E. M. Hamilton... 147
		Special correspondence	W. H. Shockley... 40
		Ditto	H. A. Titcomb... 147
		Ditto	Editorial... 854
		Spilsbury, E. Gybbon	Obituary... 882
		Ditto	722
		Spruce Monarch Co.	Editorial... 927
		Spurr, J. E.,	Resident observer... 148
		State government for Mexico	246, 286
		Statement by Mr. Hoover	163
		Statistical review for 1919	202
		Review of base-metal production	273
		Review of metal production in 1919	T. A. Rickard... 705
		Summary of Bunker Hill operations	367
			Walter S. Weeks... 667
		Steam thawing of frozen gravel	Registration of engineers... 667
		Stevens, Arthur W.,	Stevens, William S., affidavit in Minerals Separation case... 912
		Stevens, William S., affidavit in Minerals Separation case	T. A. Rickard... 337
		Stopping at Bunker Hill mine	L. A. Fenner... 298
		Stock raisers and mineral lands	Engineering Employment Bureaus... 405
		Stoughton, Bradley	Stow Manufacturing Co., flexible shafting... 361
			Stowell, E. G., and Will H. Coghill... Experimental flotation of low-grade quicksilver ore... 117
		Strategy of minerals	Editorial... 780
		Stretch, R. H.,	Future of interior Alaska... 595
		Strike at Bingham, Utah	281
		At Butte	Editorial... 628

Q

Quicksilver industry in Italy	424
Ore-fotation	E. G. Stowell and Will H. Coghill... 117

R

Railroads	Editorial... 257
Problems	474
Rakha Hills mines	605
Rand, hanging-wall support	L. W. Macer... 539
Mining shares	Editorial... 626
Neutralizing mine-waters on	F. Wartenweiler and E. H. Croghan... 376
Ransome, F. L.,	T. A. Rickard... 262
Ray Consolidated Copper Co., company report	289, 511, 732, 839
Reaction of manganese industry	H. A. C. Jensen... 21
Read, T. T.,	Panama museum... 40
Reagents in flotation	H. L. Sulman... 15
Recent metallurgy at Trail, B. C.	F. H. Mason... 863
Refrigeration, elements of, new book	Arthur M. Greene, Jr... 290
Registration of engineers	Fernando Montijo... 405
Ditto	Arthur W. Stevens... 667
Report of Engineering Council	232
Regulator for motor on pressure systems	734
Reid, John S.,	Mechanical drawing, new book... 290
Resident observer	Stable government for Mexico... 148
Resignations from U. S. Geological Survey	Editorial... 1
Resolutions of the International Mining Congress	Editorial... 699
Re-treating Tamarack sands	951
Revolt of Sonora	Editorial... 592
Rice, F. Seward,	Features of electrical equipment at Alaska Juneau... 251
Rickard, T. A.,	Chapter in journalism... 745
Ditto	The Bunker Hill Enterprise... 5, 41, 109, 185, 261, 337, 485, 525, 703, 791
Ditto	Herbert Hoover, a sketch... 494
Ditto	Romance of mining discovery... 669
Ditto	Technical writing, new book... 696, 816
Ditto	Technical writing: Jargon... 640
Riddell, W. C.,	Analysis of magnesite... 943
Robinson & Co., Dwight P.,	661
Rodenhauser, W., J. Schoenawa, and C. W. Vom Baur,	Electric furnaces in the iron and steel industry, new book... 624
Romance of mining discovery	T. A. Rickard... 669
Rose, Joshua,	Complete practical machinist, new book... 435
Ruby Hill Development Co.	353
Russian copper refinery under Bolshevik control	R. G. Knickerbocker... 677

S

Safety-first at Butte	502
Convention	Editorial... 216
Sales-centre for machinery	Howard R. Ward... 362
Sampling and mining	Editorial... 439
Combination method in mines	Morton Webber... 303
Of mines	294
San Antonio 'Express'	Editorial... 181
Santa Gertrudis Co., company report	250
Santa Maria mine	R. B. Brinsmade... 87
Schoeller, W. R.,	Analysis of minerals and ores of rarer elements, new book... 69
Schoenawa, J., W. Rodenhauser, and C. H. Vom Baur,	Electric furnaces in the iron and steel industry, new book... 624
Scientific Press, reproduction	739

Mining and Scientific Press

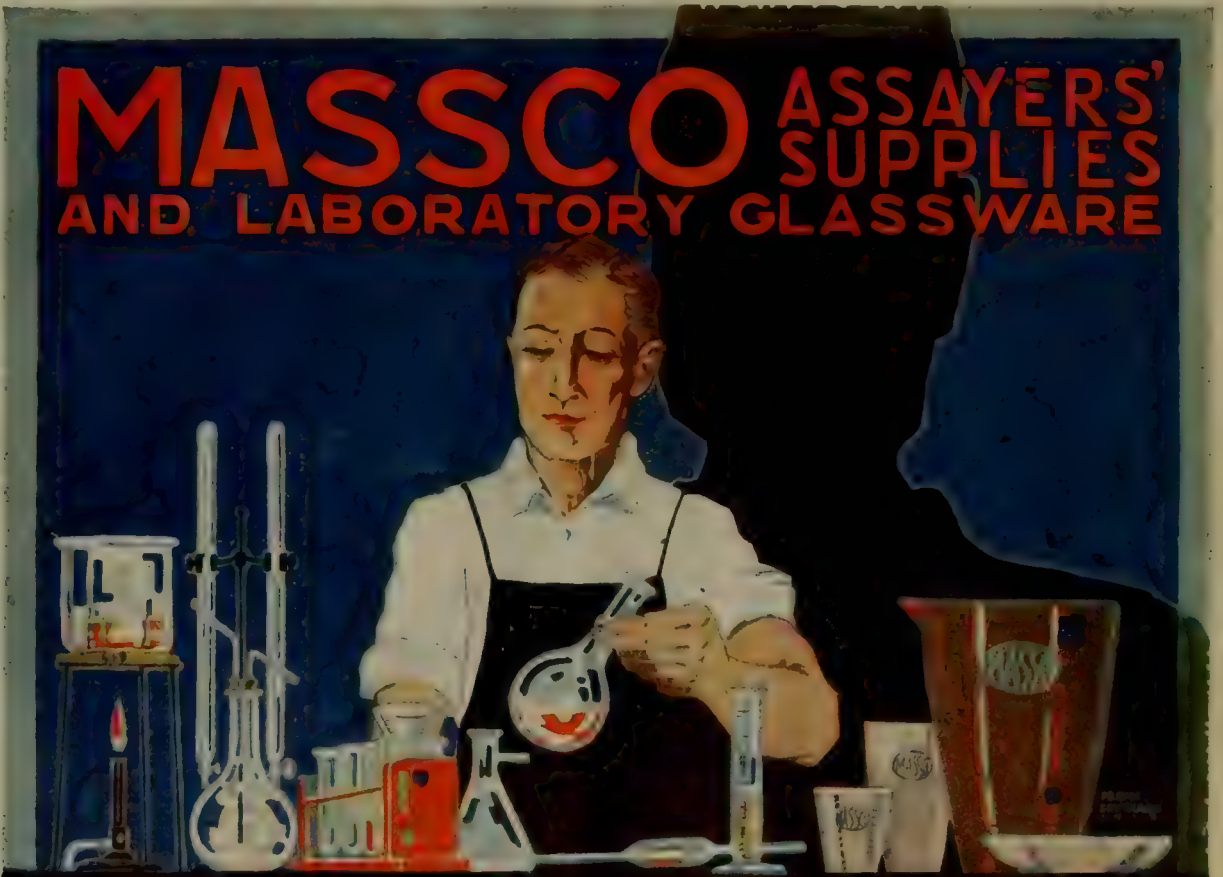
Entered at the San Francisco postoffice as second-class matter

SAN FRANCISCO, JANUARY 3, 1920

Volume 120 No. 1
15 Cents per Copy; \$4 per Year

AN INDEPENDENT WEEKLY PAPER OWNED, EDITED, AND MANAGED BY ENGINEERS

MASSCO ASSAYERS' SUPPLIES AND LABORATORY GLASSWARE



Always ready for immediate shipment

Heusser Balances -
McCool Pulverizers
- Samson Crushers
- Lindsey Furnaces
- Laboratory Specialties - Crucibles
- Scorifiers - Muffles

The quality of MASSCO assayer's and laboratory supplies is maintained by careful selection of American-made goods. The MASSCO line covers every need of the technical man whether in the field or in the laboratory.

WRITE FOR THE NEW CATALOG, JUST PUBLISHED.

The Mine and Smelter Supply Company

DENVER SALT LAKE CITY



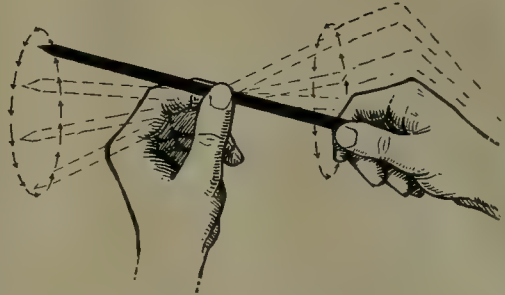
EL PASO

NEW YORK

- C. P. and Commercial Chemicals
- Laboratory Glassware - Thermometers - Scientific Instruments.

This Is the Mitchell Movement

Hold a pencil tightly at its center with the thumb and forefinger of one hand, while you describe a circle with the point.



That is the motion transmitted to the screen cloth in the Mitchell Electric Vibrating Screen. The vibrations have an amplitude of $\frac{1}{8}$ inch and are communicated to the screen cloth by means of arms or plates which are clamped to the vibrator shaft at each end and are in constant contact with the screen cloth.

The rotary character of this movement and the fact that it occurs 3,600 times a minute and forces the meshes up into the material with an impact of from 500 to 1,000 pounds explains why the Mitchell has come to be known as a revolutionary departure in screen construction. And also why it is breaking all previous records for large tonnages, thorough screening and economy of operation.

The foregoing is but the briefest outline of the Mitchell construction.

Write for our illustrated booklet which explains this remarkable screen in detail.

**The Mitchell is superior in
all screening—coarse or fine,
wet or dry.**

Stimpson Equipment Co.

*Manufacturers and Sole Agents of Mitchell Electric Vibrating Screens
and Janney Flotation Machines*

318 Felt Building

Salt Lake City, Utah

Diamond Drilling in Cornwall



The Prince of Wales visits his Sullivan Diamond Drill

IN the Cornish tin mines, the introduction and use of SULLIVAN DIAMOND DRILLS during the past three years has led to the discovery of important new mineral bodies.

Sullivan Drills are now "standard" in Cornwall, as in all mining districts, the world over.

Ask for Catalog 269

THE accompanying photograph was taken on the occasion of a visit of the Prince of Wales, who is also the Duke of Cornwall, to the Kit Hill Mine in June, 1919. The Western Morning News of June 11th says, "Because of the enterprise of the Duchy management in installing up-to-date machinery, these mines are providing valuable quantities of tin and wolfram, the supplies of the latter having proved of great national service during the war."

"The Prince showed a decided aptitude for making the most of his time, for he at once proceeded to view what is probably the most interesting feature of the mines, the new Sullivan Diamond Drill, which began its work of boring on May 28th. This drill bores out a core of rock about one inch in diameter, from which can be learnt the properties of the lode, the object of the drill being for prospecting. It has already bored about 120 feet, the average being about 12 feet per day (horizontal holes in single shifts), and its ultimate depth will be over 700 feet. * * * The Prince spent some time watching the drill at work and displayed a very keen interest, asking many questions relative to the working of the drill. Specimens of metal which had been extracted by the drill were also shown him."

The Prince is the man close to the swivel head, watching the machine work.

SULLIVAN MACHINERY COMPANY

Algiers
Boston
Butte
Cleveland
Denver, Colo.
Duluth
Dallas

Huntington, W. Va.
Joplin
Juneau
Knoxville
London
New York

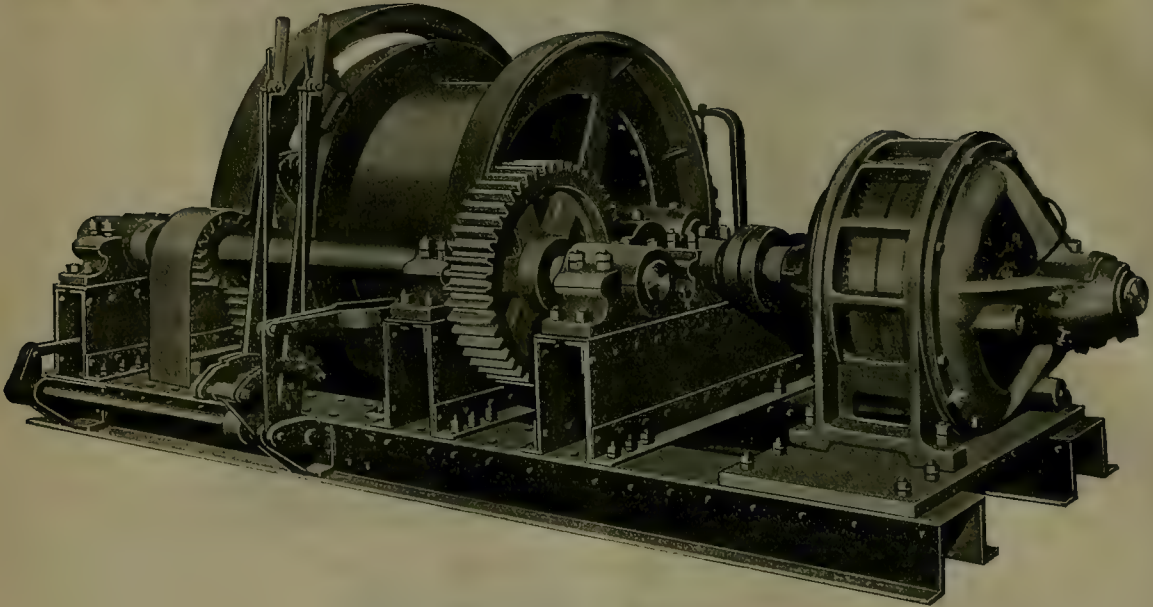
123 South Michigan Avenue, Chicago, Ill.

580 Market Street, San Francisco, Cal.

Nelson, B. C.
Paris
Pittsburgh
St. Louis
Salt Lake City
Santiago

Seattle
Spokane
Sydney, N. S. W.
Toronto
Turin
Vancouver

INDIVIDUALITY



FIFTY YEARS of Mine Hoist building are back of this

"SPECIAL" VULCAN STEEL FRAME ELECTRIC HOIST

Designed for unusually severe service, its construction in every detail is massive, yet compact.

The hollow built up girders forming the main frame elements offer the greatest possible strength. The pinon on the motor shaft is carried on a separate shaft running between two bearings. The motor drives this shaft through a Francke coupling. The intermediate gear also has a bearing on both sides.



Have you seen the
DRAKE
LOCK
NUTS?



Ask us about them.

VULCAN HOISTS are built in all sizes and for any service.

Correspondence is invited. When writing ask for our monthly H & B BULLETIN. No obligation.

THE HENDRIE & BOLTHOFF

MANUFACTURING AND SUPPLY CO.

SINCE 1861

DENVER, COLORADO

"If Better screen cloth were possible Ludlow-Saylor, would weave it"



Screens that last!

Modern milling methods require screens of long life and service. The wires *must stay put*—and stand up under hard usage. Uniformity of product and quick discharge are essential even to the last shred of screen.

"Perfect" WIRE CLOTH double crimped

is the perfect screen in every sense of the word. It is uniform, stays rigid and out-wears all other types. Its flat surface and compact structure enables the fine material to be discharged rapidly and completely.

"It's the Double Crimp that counts"

The warp and shoot wires curve gradually over and under each other. The wires are crimped *not bent*. The result is a screen—structurally correct.

The full strength of each wire is retained and long life of useful service is assured.

Send for catalog containing valuable screening data. It is yours for the asking.

LUDLOW-SAYLOR WIRE COMPANY

Manufacturers of "Perfect" Double Crimped Wire Cloth and
REK-TANG Screens

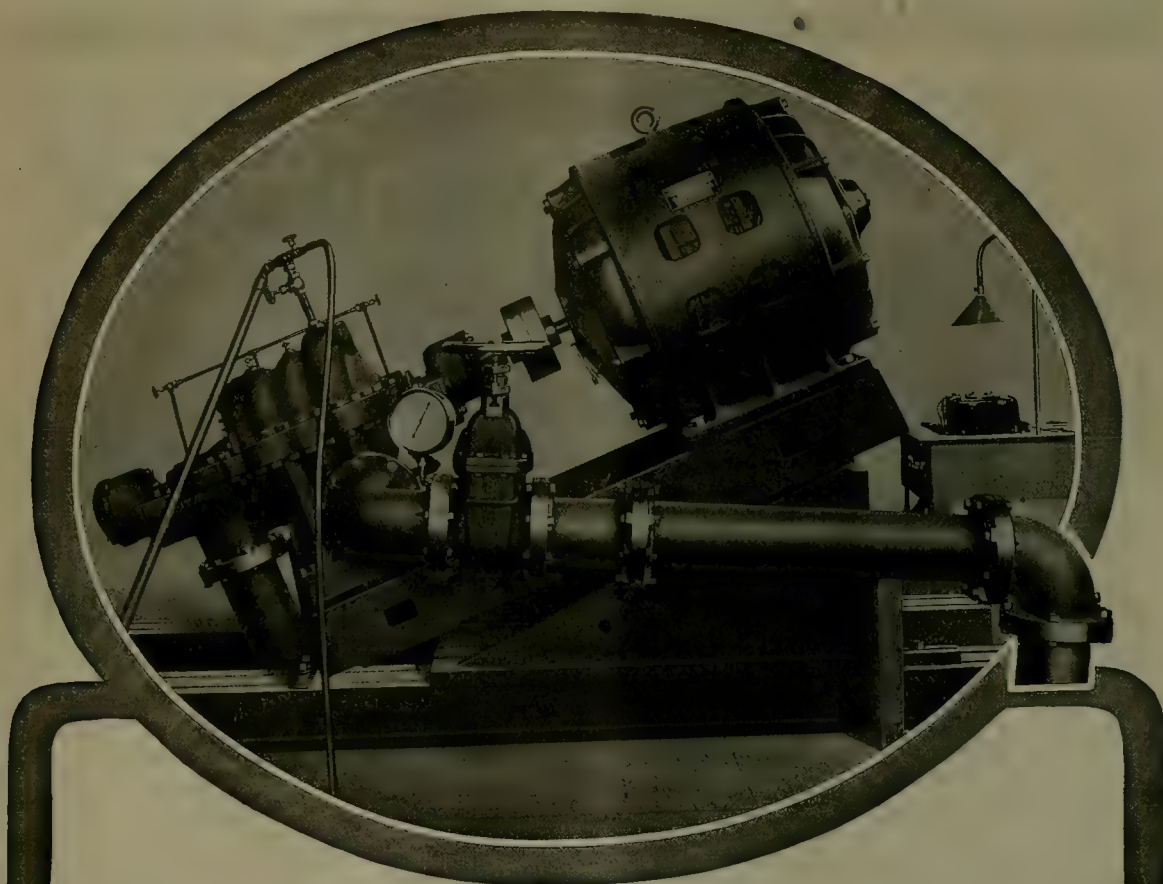
General Offices and Factory: **ST. LOUIS, MO.**

Branch Offices:

20 East Jackson Bldg.,
Chicago, Ill.

Felt Bldg.,
Salt Lake City, Utah

Martin Bldg.,
El Paso, Texas



Ready for the Coal Mine

When a pump leaves the Allis-Chalmers shops it is a certainty that it is all right in every respect, capable of reliable service for years to come.

This photo shows the thorough test given this 8-inch 3 stage Motor Driven Centrifugal Pumping Unit in the Allis-Chalmers testing Laboratory. The unit will later be mounted on a truck and operated on a slope in a coal mine.

The remarkable success of Allis-Chalmers Mine Pumps is due primarily to the fact that these pumps are designed and built for mine

service. And for that reason are in operation in many of the largest mines in the country discharging against heads as high as 1000 feet. They are—when circumstances demand it—built of an acid-resisting bronze.

This is only one kind of service for which our lines of high grade centrifugal pumps are adapted.

Our Engineering Service Department will assist on any mine pumping problem or other kind of pumping proposition. Bulletins on request.

Offices in all Principal Cities

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.



Everybody's pleased with **VICTORY B-42 CRUCIBLES**

From the president right down to the shopman everybody's pleased with VICTORY B-42 CRUCIBLES because of the trouble they save and because of the results given. It is this all 'round satisfaction that makes **VICTORY B-42 CRUCIBLES** "the crucibles you buy again."

In making Victory Crucibles we use the highest grades Ceylon graphite—proved best for crucible practice.

We determine the correct pressure to put upon the clay in order that the crucible-walls may be homogeneous and, therefore, less liable to pit or crack.

Exactly the right degree of burning is given to obtain the most ideal calcination.

We take the pick of workmen from the New Jersey pottery-field and subject their work to a rigid examination.

Such is the care and experience represented by every VICTORY CRUCIBLE.

You do not know all that crucibles can be until you have tried **VICTORY B-42 CRUCIBLES**.

Interesting data on crucible practice will be mailed upon request.

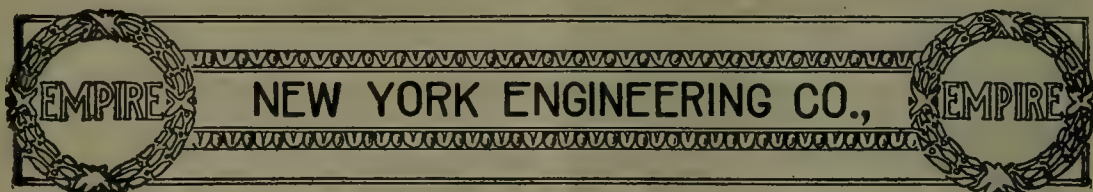
Jonathan Bartley Crucible Co.
OXFORD STREET TRENTON, N. J.

PACIFIC COAST REPRESENTATIVES:

The Merrill Company

125 Second Street

San Francisco, Cal.



First All-Steel Dredge Built in America



This dredge was designed and built by us in the record-breaking time of 4 months 15 days. It was erected and put in operation by us in the heart of Siberia, in the record-breaking time of 93 days.

It has been operating over 8 years, and the General Manager now writes us that "The Kolchan Dredge is still going strong and running well; with green Russian and Chinese winchmen, and many changes of crew during the season, we still had a running time of 86%, which speaks well for the dredge."

If you have a difficult dredging problem, submit it to us. We have installed Empire equipment in all parts of the world, including our **GOLD DREDGES, EMPIRE HAND PROSPECTING DRILLS, SLUICES AND RIFFLES, PIPE LINES AND GIANTS.**



Our plant is most favorably located for export shipments, being on tide water at Yonkers, N. Y., and on the New York Central Railroad. It was designed and built by us specially for turning out our own line of work.

NEW YORK ENGINEERING COMPANY
OFFICE: 2-RECTOR STREET, NEW YORK
WORKS AT YONKERS, N. Y.

How Much of Your Power Reaches the Crushing Surfaces?

The average gyratory spends a great percentage of power in bending its long, slender shaft—not in crushing your rock or ore. The natural result is loss of efficiency and decreased output.

The short, rigid and far stronger shaft in

TRAYLOR "Bulldog" Gyratory Crushers

is your assurance of real crushing economy—the maximum output with the minimum operating and upkeep costs.

The Bend-Proof Shaft is only one of the many exceptional "Bulldog" features. The Hewes Spider—the perfect, force-feed lubrication—the cut steel gears that run in oil—these and other noteworthy improvements will justify your most careful attention.

Write for
Bulletin PGX-1
It's just off the press

Traylor Eng. & Mfg. Co.

ALLENTOWN, PA.

New York:
30 Church St.

Pittsburgh
211 Fulton Bldg.

Chicago:
1414 Fisher Bldg.

Los Angeles:
Citizens Bank Bldg.

Spokane:
Mohawk Block





This shows the largest Continuous Stave Wood Pipe in the world at the time installed. This installation was made for the Northwestern Electric Company of Portland, Oregon, under the supervision of the Stone and Webster Engineering Corporation of Boston, who were general contractors on the work.

The installation consists of a mile of wood stave flow line 162" or 13'-6" in diameter.

The normal capacity of the system is 1230 cu. ft. per sec., velocity 8.6' per sec., maximum static head on wood pipe 154', wheel capacity 20,000 H. P.

View showing a Continuous Stave Pipe Line constructed for the Great Northern Railway Company in the Cascade Mountains. This pipe carries the water to the turbines which generate the electric power used to operate the giant electric locomotives that pull the trains over the mountains.



Redwood — Douglas Fir

WOOD PIPE
CONTINUOUS STAVE-WIRE WOUND-BORED

Do You Know

THAT the use of wood pipe antedates that of practically every other form of pipe, being used more than two centuries ago in London and at a much earlier period in some other European cities

THAT one of the original London companies—an extensive user of wood pipe—organized to supply that city with water, is still operating; and that some of the wood pipe laid during the reign of Queen Anne when recently replaced with larger mains was found to be in a state of perfect preservation

THAT citizens of Fayetteville, N. C., are receiving water through wood pipe that was laid in 1829—the pipe still being sound

THAT the large wood stave pipe which carries the water to the pumps of the city water works of Manchester, N. H., was laid in 1874, and the superintendent of the works said a short time ago: "We know nothing of its condition, as it was laid six feet below the surface and we have had no occasion to disturb it."

THAT modern wood pipe, size for size, will carry a greater volume of water than any other pipe made

THAT wood pipe is the only pipe whose capacity does not decrease with age

THAT many of the foremost cities of the world are receiving their supply of pure water thru wood pipe

THAT wood pipe is today carrying the water which makes hundreds of thousands of acres of once desert land bloom like a veritable garden.

THAT wood pipe is most easily adapted to difficult installations

THAT wood pipe is the most economical pipe to install and maintain and is the most efficient in service

THAT the present big users of wood pipe are the best prospects of future sales when further installations are required

THAT there is only one strip of land in the world on which the Redwood and Douglas Fir grows that provides material for the perfect staves of which correctly made wood pipe is formed—the Pacific Slope from Northern Washington on down through California

THAT we have engineers widely experienced in hydraulic problems who will frankly and honestly consult with you regarding the advisability of wood pipe for any project or installation

THAT you are not asked to buy wood pipe unless it is absolutely the best pipe for your purpose regardless of how much you want to invest; and further, that if you buy it, you will be instructed as to its proper use so that the fullest measure of utility may be obtained from it

THAT when we tell you wood pipe is the pipe for you to use there are thirty years of experience and an enviable record behind our statement

THAT full information—booklets—reliable data and suggestions of experts may be obtained by you for the asking?

(Tell us your problems)

WESTERN WOOD PIPE PUBLICITY BUREAU

GENERAL OFFICES, WHITE BUILDING, SEATTLE, U. S. A.

American Wood Pipe Company
Tacoma, Wash.

Redwood Manufacturers Company
San Francisco, Cal.

Pacific Tank & Pipe Company
San Francisco, Cal.

Continental Pipe Mfg. Company
Seattle, Wash.

Redwood — Douglas Fir

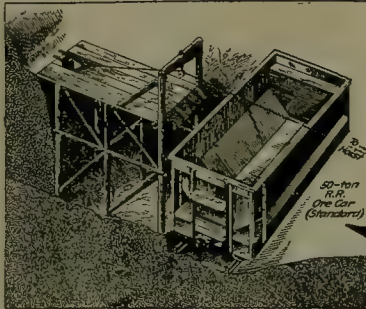
WOOD PIPE

CONTINUOUS STAVE-WIRE WOUND-BORED

Loading a Stockpile With a Scraper

By D. E. A. CHAMLTON

A device which was used in loading a small iron-ore stockpile on one of the Minnesota ranges is illustrated in the accompanying sketch.



LOADING A STOCKPILE WITH A SCRAPER

A small loading platform of 8-in. diameter round posts and 2-in. plank was constructed near the track, which was continued some distance beyond the shaft to permit the spotting of coal cars. The two uprights on the track side were extended above the top of the platform and connected so that they formed a frame, from the center of which was suspended a small block pulley. The platform was about three feet above the top of the cars, but sloped on the outer edge so that the ore would run into the cars. An ordinary road scraper was used, fastened to $\frac{1}{2}$ -in. cable passed through the pulley and attached to a small hoist, which was furnished with steam from the boiler house. The far side of the stockpile was removed first. The operation of the scraper required two men.

Engineering & Mining Journal

This is a job for the "Little Tugger"

A one-man, portable, powerful, reversible hoist, operating on compressed air or steam. Miners, quarrymen and contractors find it indispensable for hoisting timbers and machinery, hauling cars and drags and skidding crates and lumber.

"Little Tugger"

Hoists 1000 lbs. with a rope speed of 85 ft. per min. Has a car haulage capacity ranging from 50,000 lbs. at 0 to 1090 lbs. with a 63 degree angle of inclination. Has a drum capacity of 700 ft. of $\frac{1}{4}$ -in. cable.

IT SOLVES THE LEND-A-HAND EVIL.

Bulletin No. 4333 tells complete story.



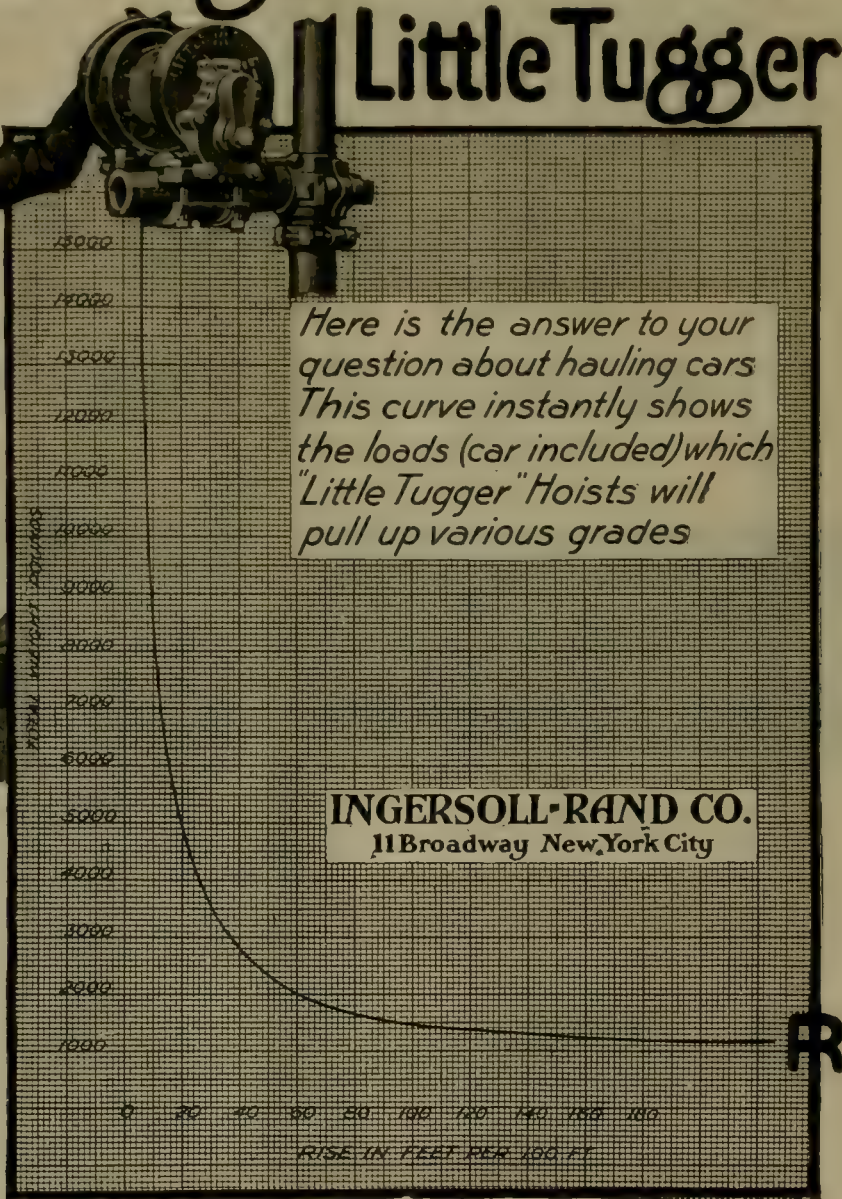
80-LH

Ingerso

The Haulage Curve of Little Tugger



Ask for
Bulletin 4333



79-LH

11-Rand

Less Friction—Better Galvanizing—Clean, Smooth Surfaces and Other Advantages Characterize

“NATIONAL”

Welding-SCALE FREE Pipe

(Butt-weld pipe with the heavy mill-scale, or welding-scale, removed)



Ordinary black butt-weld pipe, showing characteristic coating of welding-scale.



“NATIONAL” Welding-SCALE FREE Pipe, showing clean, smooth surfaces of this modern product.

The advantages of the product and the process of manufacture are described and illustrated in “NATIONAL” Bulletin No. 7—MANUFACTURE and ADVANTAGES of “NATIONAL” WELDING-SCALE FREE PIPE



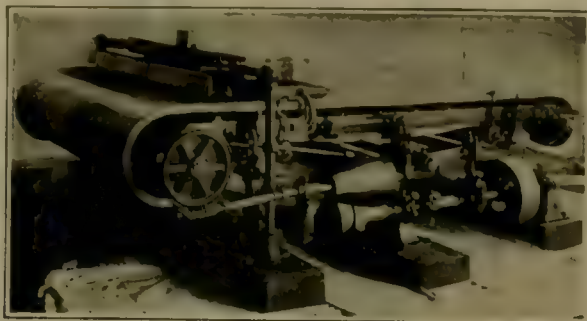
NATIONAL TUBE COMPANY, PITTSBURGH, PA.

General Sales Offices : Frick Building

DISTRICT SALES OFFICES

Atlanta Boston Chicago Denver Detroit New Orleans New York Salt Lake City Philadelphia Pittsburgh St. Louis St. Paul
PACIFIC COAST REPRESENTATIVES : U. S. Steel Products Co. San Francisco Los Angeles Portland Seattle
EXPORT REPRESENTATIVES : U. S. Steel Products Co. New York City

The ONLY



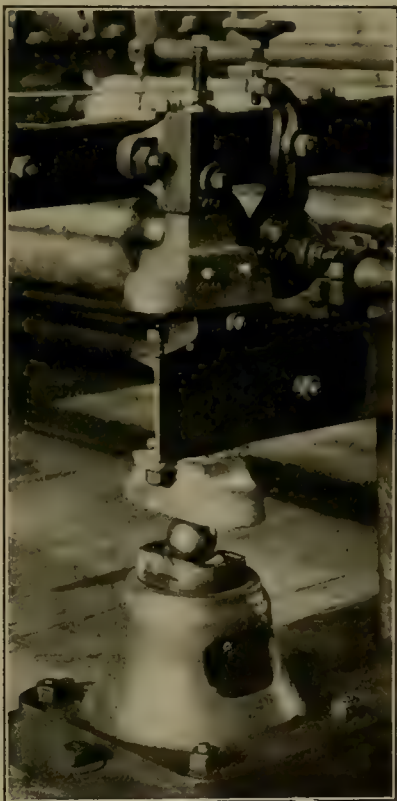
Large Capacity Vanner Is The SENN

Vanners Save More Concentrates than any other gravity concentrators.

One SENN has the Capacity of Four Ordinary
(old fashioned,) Small Capacity Vanners.

Small Capacity Vanners are All Old Fashioned.

An Up-to-date SENN has a Capacity equal to the best "table", but it makes a Recovery equal to or better than the best vanner of any other kind.



Detail of Ball Bearing

The Large Capacity of the SENN is due to its Continuous circular "panning" motion, which keeps the gangue suspended in a thick pulp (35% solids), and to the thick pulp that is made possible by the Continuous circular motion.

The High Recovery is due to the Continuous circular "Panning" Motion that keeps the pulp loose, giving the gangue a wash in all directions, preventing small particles of concentrate from riding into the tailings on top of larger pieces of gangue, and allowing the smallest particle of concentrate to settle through the loose gangue onto the moving vanner belt, to be withdrawn by it and saved.

The High Recovery is also due to the Thick Pulp used on the SENN. Its feed usually contains not more than Two Tons of Water per Ton of Solids. Ordinary (old-fashioned) vanners require from five to eight tons of water per ton of solids. "Tables" require from three to five tons of water per ton of ore, in the feed.

The Greater the Amount of Water used, the Greater the Proportion of Fine Concentrates Washed Into the Tailings.

USE SENNS TO RECOVER ALL YOUR CONCENTRATES.

Senn Concentrator Co.

1215P First National Bank Building

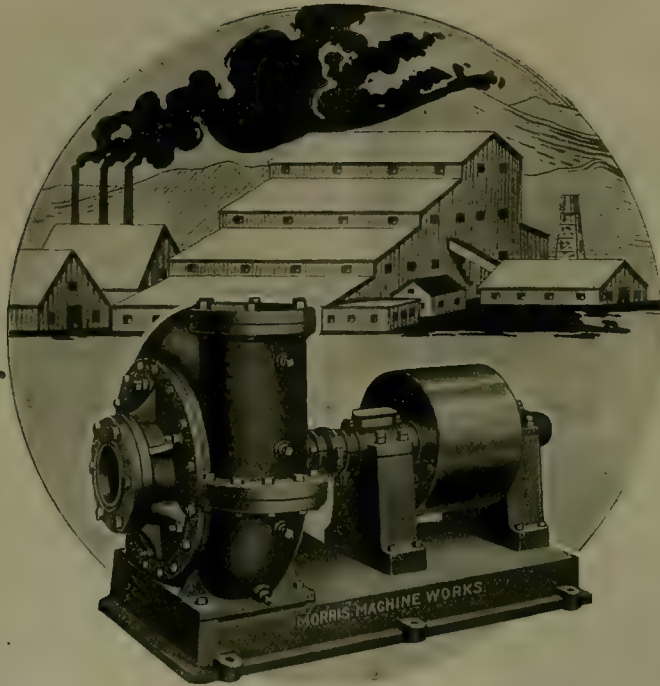
Cable Address,—"Sennpan"

San Francisco,

United Filters Corp., Salt Lake City
Southwestern Engineering Co., Los Angeles
Hallidie Machinery Co., Seattle
Tonopah Machinery Co., Tonopah
F. H. Jackson, Sydney, N. S. W.

Federal Export Corp., Lima, Peru
Rintoul and Davis, Johannesburg, South Africa
Oliver American Trading Co., Eagle Pass, Texas

MORRIS



RELIABILITY is the sought-for feature in every pump. It is the point of greatest certainty in MORRIS PUMPS. Their reliability and efficiency have been established in practically every mining district of the world. More than sixty thousand are in use.

MORRIS PUMPS are considered as STANDARD for handling

tailings or slimes, for pumping phosphate, for work with giants, or for sinking. Morris Pumps were used in the Kerr Lake and Carson Lake dewatering projects.

No matter how difficult your pumping conditions, MORRIS PUMPS will meet them as they have for other mines, from smallest to largest, the world over.

Morris pumps, dredges and engines are described in a 126-page book, usefully arranged, which will be sent without obligation upon request.

Since 1864 builders of Centrifugal Pumps, Hydraulic Dredges and Steam Engines

MORRIS MACHINE WORKS

BALDWINVILLE
NEW YORK

Branches in Principal Cities



What "Stoper" Means to Most Miners

THE splendid performance of the Waugh stoper, throughout the years since the air-feed stoping drill made its first appearance, has built up in the miner's mind such absolute faith in its superior qualities that whenever he says "stoper" now, you can count upon it, he means a "Waugh".

EITHER the "16-V" or the later "70" Waugh valveless stopers, installed in your mine, will mean steadier, stronger, speedier, less expensive and more satisfactory stope drilling, contented drill-runners, and increased production.

Our Stoper Bulletins will interest you. Send for them.

THE Denver Rock Drill Manufacturing Co.

Denver, Colorado

San Francisco
Scranton
El Paso

Los Angeles
Seattle
Salt Lake City

Joplin
Wallace
Birmingham

Lima
Santiago
Mexico City

New York City
Houghton
Belle

Melbourne
Johannesburg

Canadian Rock Drill Company, Limited
Sole Agents in Canada

Toronto, Ont.

Cobalt, Ont.

Nelson, B. C.

Vancouver, B. C.

THE JORDAN SPREADER

The Greatest Money Saver of Them All



If you have rock, sand, snow, ice, overburden, tailing, ore, slag, or any similar material to dispose of; if you have any filling to be done; if you have stock piles or tailing piles to be built; railway maintenance to be taken care of; the Jordan Spreader will effect savings of upwards of \$7000 a day.

A FEW HOURS WORK OCCASIONALLY WILL SOON PAY FOR A JORDAN

It is not necessary for the Jordan to be in continuous operation to be profitable—it is employed with big profits by small as well as large operations. It practically dispenses with gang labor when bulk material is to be handled and does the work in a very small fraction of the time required by hand labor.

Built in our own shops, the material and workmanship is of the best. The construction is such as to last a life time—numerous Jordans have been in use over twenty years.

LEARN MORE ABOUT THE JORDAN.
LET US DISCUSS YOUR OWN PRO-
BLEM WITH YOU.

THE O. F. JORDAN COMPANY

CHICAGO and KENNEDY AVES.

EAST CHICAGO, IND.



Among the Users of JORDAN SPREADERS

Anaconda Cop-
per Co.

Utah Copper Co.

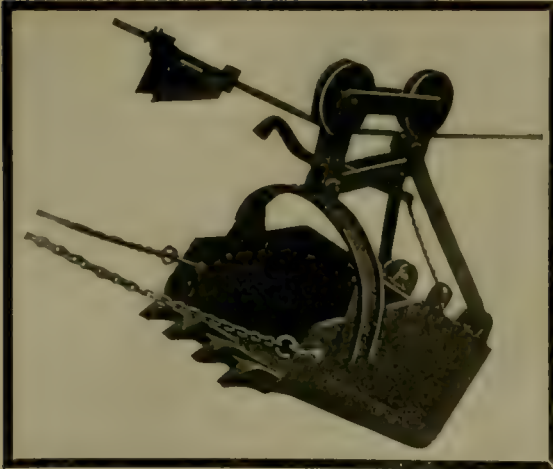
New Cornelia
Copper Co.

Calumet Arizona
Smelting & Re-
fining Co.

Oliver Iron Min-
ing Co.

M. A. Hanna Co.

Etc., Etc.



*You can't
Improve on this
for
Simplicity and
Economy*

PIONEER BACK DUMP BUCKET

PATENTED

is strictly an all purpose bucket

For handling tailings, for stripping operations, in placer mining for construction work of all sorts the Pioneer Back Dump Bucket is a money-saver.

The Back-Dump feature cuts down clearance required between cable and tower top. Pioneer Back Dump Buckets can be made to trip while traveling in either direction.

*Manufactured by the Mansfield
Engineering Co., Indianapolis, Ind.*

IMMEDIATE DELIVERY FROM STOCK.

SOLD IN THE WEST

Collins & Webb

INCORPORATED
MACHINERY

447-449 East 3rd St., Los Angeles, Cal.

229 Rialto Bldg., San Francisco, Cal.

CRUSHERS
ROLLS
CONVEYORS

AIR COMPRESSORS
BALL MILLS
AERIAL TRAMS

OIL ENGINES
ROCK DRILLS
TUBE MILLS

CONCENTRATORS
PUMPS
DRYERS



Three requisites of a good bearing.

Good babbitt

The "Dodge" brand of bearing metal is made for general mill and factory work. It is the babbitt regularly used in Dodge bearings and is one of the main factors in their successful economical operation. It has been used in the Dodge factory for more than thirty years.

We make nine other grades of bearing

metal to meet all requirements from light loads and low speeds to heavy loads and high speeds.

Each grade is the result of many tests to determine the composition which will give the greatest wearing and the highest anti-friction qualities in the service for which it is made.



Dodge capillary oiling bearing



Dodge ring oiling bearing



Dodge standard bearing

The right length or bearing area

Economy in power transmission requires that a film of oil be maintained between shaft and bearing. Long experience has taught that the best results are obtained from bearings approximately five times as long as the diameter of the shafts that pass through them.

Dodge bearings are proportioned on this basis. The increased square inch pressure of the shaft in a shorter bearing breaks down the oil film causing increased friction and wear. The greater area of a longer bearing causes power waste.

Positive methods of lubrication

The Dodge capillary oiler is a wooden block with alternate saw cuts through which the oil rises by capillary attraction from the reservoir to the shaft. In this bearing there is not the slightest churning or whipping of the oil.

It takes its supply from the center of the oil chamber. As all sediment settles to the bottom, only clean oil is used.

The law of capillary attraction is unfailing. Your shaft is well oiled as long as there is oil in the reservoir.

The ring oiling bearing lubricates by means of rings driven through the oil chamber by the friction of their own weight upon the shaft. With this bearing the oil is applied at the top of the shaft where there is no pressure.

The standard bearing is lubricated by oil-saturated waste placed in cups cast on the cap. This bearing is relatively inexpensive and gives good service in certain classes of work.

The Dodge dealer in your city is equipped to give you prompt and satisfactory service. Place your orders with him.

Dodge Sales & Engineering Company

Distributor of the products of the Dodge Mfg. Co. and Dodge Steel Pulley Corporation

General Offices: Mishawaka, Ind.

Works: Mishawaka, and Oneida, N. Y.

Dodge Branch Warehouses

New York
Chicago
Minneapolis

Philadelphia
Dallas

Boston
Providence

Pittsburgh
Atlanta

St. Louis
Newark

Cincinnati
Seattle

WHEREVER there's a moving part—
driving-gears, tumbler, trommels, stacker-
conveyor, cables, or jigs—

For the rough, dirty, wet work of the gold-
dredge use none but **DIXON'S Waterproof**
Graphite Grease which gives satisfactory
lubrication—economically and unfailingly.

*Write for booklet L41-W today.
It gives complete information.*

MADISON, JERSEY CITY, N. J. 08004

Joseph Dixon Crucible Company

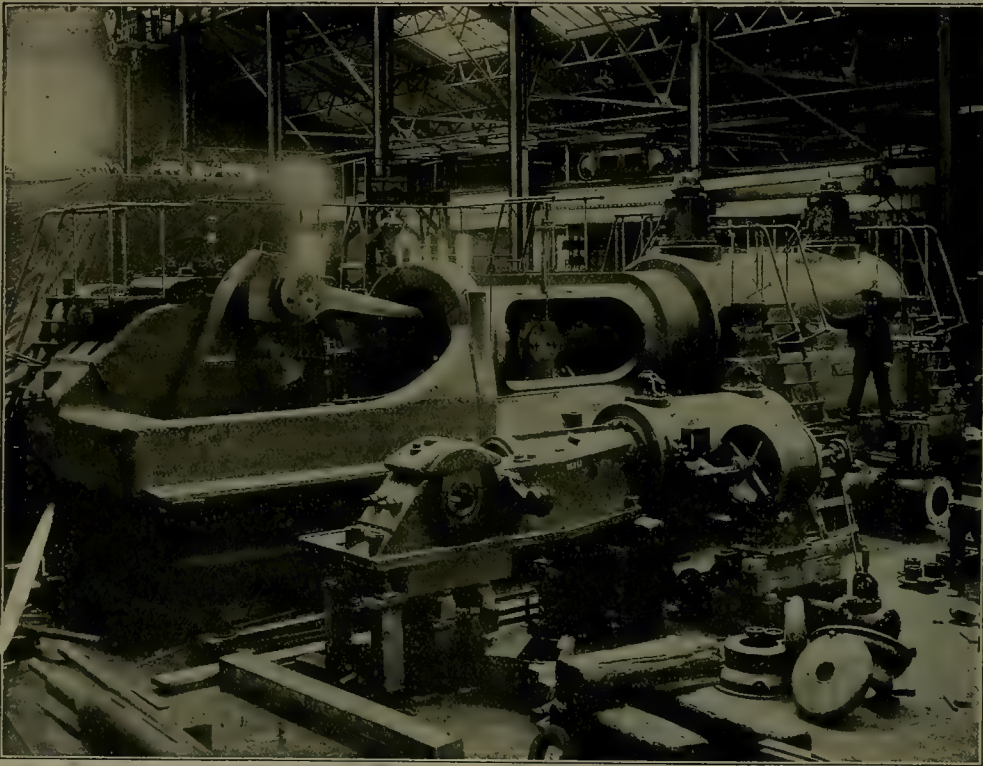
ESTABLISHED 1887

SOLE Pacific Coast Sales Office: 135 Second St., San Francisco



DIXON'S
WATERPROOF
Graphite Grease





Uniflow Poppet Valve Engines

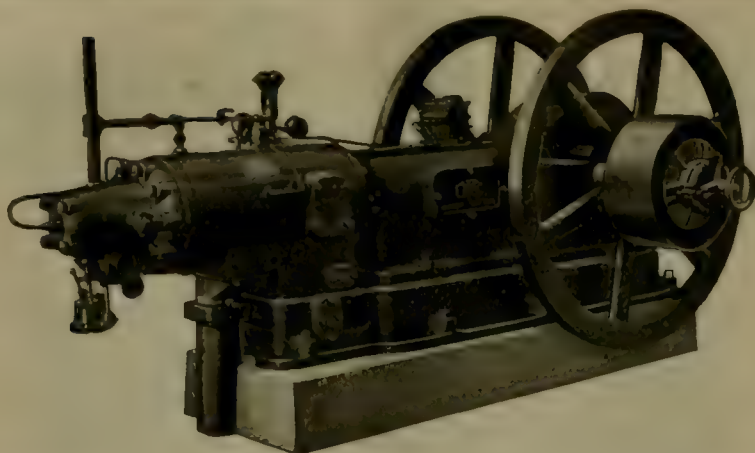
BUILT FROM 200 TO 2000 H. P.

For {
any available Steam Pressure
any available Superheat
any available Vacuum
any available Back Pressure

Under any of the above conditions these engines will operate with lower steam consumption per horsepower, over wider variations of loads, than any steam prime mover thus far developed.

If considering additional power write or call upon us.

Nordberg Manufacturing Co.
MILWAUKEE, WIS.



"Built like a high grade steam engine" in capacities from 20 to 160 H. P., in both single and duplex types, Giant Semi-Diesel Oil Engines embody such features as box type cross-head construction, hot-liner ignition, and automatic regulation. Engine units for general power purposes, or complete electric generating or pumping plants, can be supplied to meet any service conditions. Performance records of "Giant" dependability and economy under all service conditions, are available to aid in determining their value to you. Write for bulletins

Oil, the fuel for dependable power, costs less, is plentiful and readily procurable, and permits the design of engines so sturdy and simple in construction that their operation requires practically no attention beyond the supplying of fuel and lubricant.

Chicago Pneumatic Tool Company, 1081 Fisher Building, Chicago

Sales and Service Branches all over the World

BRINKHAM BOSTON CINCINNATI CLEVELAND EL PASO JOPLIN LOS ANGELES LOS ANGELES MILWAUKEE MINNEAPOLIS NEW YORK PHILADELPHIA PITTSBURGH PORTLAND RICHMOND SALT LAKE CITY SAN FRANCISCO SEATTLE ST. LOUIS TAMPA TUCSON WASHINGTON WHEELING WILKES BARRE YONKERS

EN-29

BOYER PNEUMATIC HAMMERS · · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · · VACUUM PUMPS · · · GIANT FUEL OIL, GAS
GASOLINE AND STEAM ENGINES · · · ROCK DRILLS · · · COAL DRILLS

GIANT

Dependable Power at

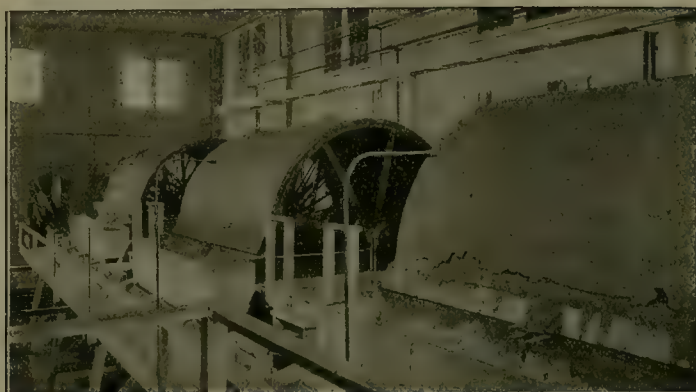


ENGINES

Less Cost Per Hour

OLIVER FILTERS

REMOVE WATER FROM YOUR CONCENTRATE
WORRY FROM YOUR LABOR PROBLEM



**Oliver Filters reduce your costs and increase
your production**

With the Oliver you reduce your risk of loss through strikes and scarcity of labor. Now, more than ever before, you must produce more at less cost. Discard the old expensive methods for the modern Oliver way.

The Oliver is the choice of the largest and most modern mills. They demand the best which is why they choose the Oliver. Follow the example of the leaders—Anaconda, Inspiration, Miami, Nevada Consolidated, Ray and others.

Write today for Bulletin 12A

OLIVER CONTINUOUS FILTER CO.

503 Market St., San Francisco

299 Madison Ave., New York

*"They can't stick"**"They won't leak"*

Install Merco Nordstrom Plug Valves Now—

Use them on all water and air lines, for cyanide and slimes solution and all general mine and mill piping. Don't put up any longer with troublesome valves that stick tight and have to be jarred loose.

THE MERCO NORDSTROM PLUG VALVE

is always *free-opening*. No matter how corrosive the solution, a turn or two of the grease screw *with the fingers* lifts the plug from its seat—and the Merco Nordstrom is easily opened or closed. It's the simple things like the Merco Nordstrom self-lubricating principle that cut costs and prevent loss.

Merco Nordstrom Valves are furnished for both flanged and screwed connections.

Descriptive literature and prices gladly furnished upon request.

THE MERRILL COMPANY

121 Second St.,

San Francisco

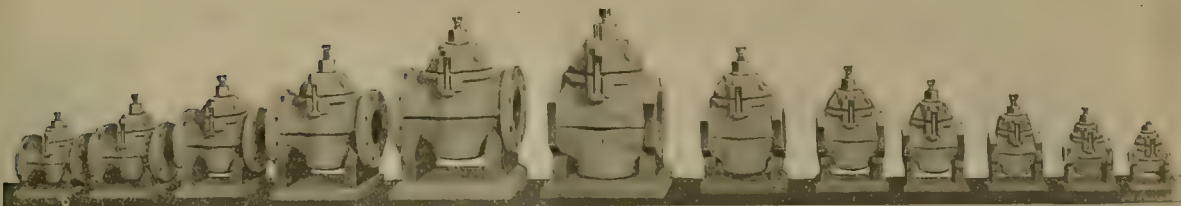
Chicago Office: 231 Insurance Exchange Bldg., Chicago, Ill.

REPRESENTATIVES:

London—C. E. Rogers, Morley House,
26-28 Holborn Viaduct, E.C. 1.

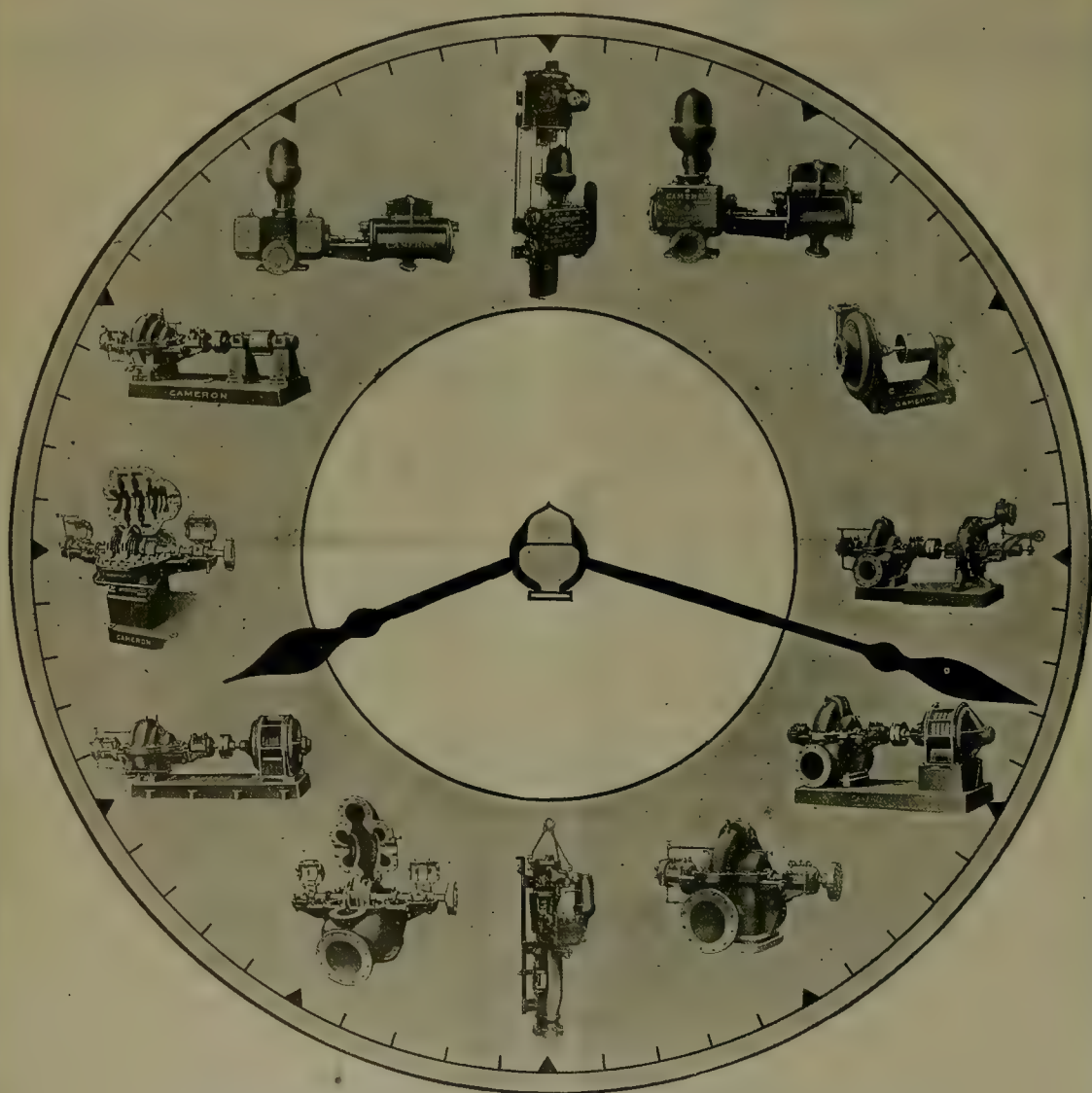
Scandinavia—Aktiebolaget Nordiska
Armaturfabrikerna, Stockholm, Sweden.

South Africa—Fraser & Chalmers, South Africa, Ltd.,
Farrar Bldg. Johannesburg, Transvaal, South Africa.



CAMERON PUMPS

Always Up to the Minute



Cameron Pumps are examples of up-to-date manufacturing methods and modern engineering practice. These are the pumps you will eventually use. Why not specify them now?

Send for Bulletins

A. S. CAMERON STEAM PUMP WORKS

11 Broadway

Offices the World Over

New York

12-CM



Too Hot to Touch

AN 18" x 6 ply Anaconda, conveying dead burned magnetite, hot enough to blister the hand, and never below 212° Fahrenheit.

This plant in the State of Washington tried out a steel pan conveyor on this job which played out in three months.

The Anaconda illustrated handles 25 tons per hour up an

18 degree incline. It is now in its second year, and shows every sign of lasting indefinitely.

To resist such high temperatures, a belt requires a careful building up of the plies, a uniform, dense impregnation and a long period of ageing under tension—processes which enter into the manufacture of every Anaconda Belt.



MAIN BELTING COMPANY - Philadelphia

New York Boston Chicago Pittsburgh Atlanta San Francisco



Pacific Products *in the Field*



A 96" Pacific Redwood Continuous Stave Pipeline was built and installed for the Pacific Gas & Electric Co. at Clipper Gap, California.

The best test of the worth of a product is the type and character of the buyer. The largest public service corporations, mining companies and industrial establishments are users of Pacific Products—wood tanks and pipe.

No higher endorsement of their quality and durability could be given.

Day after day re-orders are received—Discriminating engineers specify Pacific Tanks and Pipe because they know that they are buying standard equipment.

Write for information and prices



PACIFIC TANK & PIPE CO.

THE STANDARD SINCE 88

General Office: 302 Market St., San Francisco
BRANCH OFFICES:

Los Angeles
Salt Lake City

902 Trust & Savings Bldg.
329 Newhouse Bldg.

New York
Philadelphia

507 St. Paul Bldg.
220 Broadway

Mining and
 Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Deery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JANUARY 3, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

Page	
NOTES	1

MR. HOOVER ON NATIONAL ECONOMICS..... 3

Comment on his article in the 'Saturday Evening Post'. The gist of it. Equality of opportunity. Class distinctions are undesirable. The chief aim to improve the standard of living. The useful stress of competition. Unfair division of profit. Trades-unions and combinations of capital. Neither must be allowed to domineer the community. Nationalization of industry fails. Government bureaucracy and its evils. Co-operation between capital and labor. Bad effects of speculation. Thriftless finance by the Government.

LET US HAVE PEACE..... 4

A New Year retrospect. The world is in a mean mood. The Armistice a disappointment. World conditions bad. The War inconclusive and the terms of ratification lacking in generosity such as would heal the hurts of war. The world has had a great fright. Resolution of New York Chamber of Commerce urging peace settlement.

ARTICLES

THE BUNKER HILL ENTERPRISE—I

By T. A. Rickard..... 5

Early exploration of the American continent. The endeavor to cross the continent and establish communication with the Pacific Coast. John Jacob Astor and the fur trade in the North-West territory. The Louisiana purchase. Lewis and Clark's overland expedition. Founding of Astoria in 1811. Oregon created a territory.

A CONTRIBUTION TO THE STUDY OF FLOTATION—I

By H. Livingstone Sulman..... 14

Explanation that delay in publishing data has been due to pending litigation. A classification of various 'float-concentration' processes. Oil not essential to the process. Classification of reagents. What agitation does. An explanation of the process, and the principles involved.

FINE-GRINDING IN BALL-MILLS

By Henry Hanson 17

The general adoption of ball-mills as grinding machines. Crushing resistance of various ores. Tests to determine comparative resistances. Factors affecting crushing efficiency. Various possible methods of including ball-mills in grinding schemes. The 'one easy step' theory has serious limitations.

THE REACTION OF THE MANGANESE INDUSTRY

By H. A. C. Jenisen..... 21

Comparison in the domestic production during nine months in 1919 and corresponding period in 1918. Various grades of ore. Shipments for third quarter show greatest decrease. Imports from foreign countries. Impetus to industry during the War due to strategic considerations. Future outlook.

DEPARTMENTS

REVIEW OF MINING.....	23
THE MINING SUMMARY.....	29
PERSONAL	30
OBITUARY	30
THE METAL MARKET.....	31
EASTERN METAL MARKET.....	32

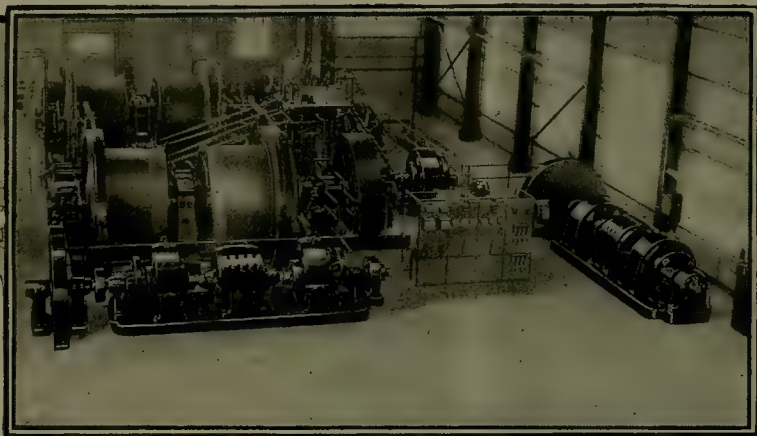
Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 351½ Woolworth Bdg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.

With power interruptions eliminated by the use of electric power, production reaches new records.



Electric Hoists Are Economical and Dependable

EIGHT times as much coal is often burned to supply steam to a small steam hoist as would be necessary to supply steam, in an efficient central station, for the generation of electric power to operate the same hoist.

Piling up of cars at the foot of the hoist is almost unknown where elec-

tric hoists are used. The steady pull of the electric hoist greatly reduces the possibility of delays due to general upkeep, repairing ropes, shaft guides, etc.

Hoist operators are universally proud of their electric hoists and anxious to have them make a fine tonnage record.

General  **Electric**
General Office **Company** Schenectady, N.Y.



COST of living, as estimated from the quotations for 96 staples, rose 1.3% in the month ending December 1, thereby bringing the index-number to a level 131% above that which prevailed before the War. It was 6.1% higher than December one year ago, just after the signing of the Armistice. This suggests how little has been done in the way of industrial reconstruction since the major fighting ceased.

BILLS designed to restrict the size of publications are before both houses of Congress. It is proposed by Senator Capper and Congressman Anthony to limit the daily newspaper to 24 pages, the Sunday issues to 36 pages, weekly periodicals to 75 pages, and monthly to 100 pages. Of course, the publishers have protested against anything so ridiculous and have insisted that any restrictions in the consumption of book paper will not remedy the insufficiency of news-print paper. It is natural that the publishers of newspapers should co-operate with the publishers of magazines, but it is a pity that the obvious waste of paper in newspapers, especially the Sunday issues, should prejudice the case of the more serious forms of periodical literature.

SETTLEMENT of our relations with Mexico is becoming more urgent as it is realized how much depends upon the stability of the oil industry in that country. More than 90% of the fuel-oil used on the Atlantic and Gulf coasts, both for bunkering ships and for industrial purposes, comes from the Mexican oil-wells, in which American and British capital and brains have been so largely invested. Of the 60 million barrels produced annually in Mexico, the U. S. Shipping Board has a contract for 21 million barrels, and by the end of the year just begun it will be using at the rate of 40 million barrels per annum. The total consumption of petroleum in the United States is 30 million barrels more than the supply, including both Mexican and domestic oil, leaving that much to be drawn from the reserves of oil that are stored in this country. The Mexican question cannot be shelved everlastingly; it must be faced and solved at no distant date.

'SIXTY-MILE gold dyke in Australia' is the heading of a dispatch in the 'Morning Scream', which proceeds to state that "a 60-mile ridge of gold" has been found near Kalgoorlie and vouchsafes the information that this is "the longest gold-bearing formation ever

found in history", or geography, presumably. This telegram, which must have been concocted under the stress of an excess of mince-pie and wood-alcohol somewhere not very far from the press-room of our contemporary, probably refers to the discovery at Hampton Plains, as described in these columns in our issue of November 8. Another fake telegram in the 'Evening Howl' recounts the discovery of rich silver ore in the Premier mine and draws attention to the Salmon River district, in British Columbia, both of which were described in our issue of November 15. Reverting to the 60-mile lode, it is a fact that the outcrop of the Main Reef series on the Rand has been traced for a distance of 55 miles. The present story, however, is more nearly analogous to the report upon a gold vein in Siberia: it was said to be nine miles long, nine feet wide, and assayed 9 ounces per ton, so that if the ore persisted for nine feet only it would yield \$54,000,000. Unfortunately the report was signed by Ah Li.

THE usual proportion of resignations from the staff of the U. S. Geological Survey has increased to an alarming extent during the past year. In his annual report the Director asserts that 77 members, or 17% of the entire technical staff, resigned to accept positions with private corporations, who offer them in every case a considerably larger remuneration. The Director has followed up 29 former cases of this character and finds that whereas the average salary of these men from the Government was \$2271, the average salary at the start in private employment was \$5121, which after two years became \$7804. Apparently the increased number of resignations is due to the decreasing margin between the salaries paid by the Survey and the cost of living. Setting aside sentimental considerations, and looking at the matter as a purely business affair, the Survey offers much to the young man newly graduated with a degree in geology. He is enabled to complete his education in the school of practical experience while earning enough to live comfortably; he gets a variety and breadth of experience such as can seldom be obtained elsewhere; he has the opportunity for building up a valuable acquaintance among influential men actively engaged in the mining industry. We believe that the unique opportunities offered by the Survey are so obviously advantageous that there will never be difficulty in recruiting suitable members for its staff. The problem is not so much to attract the best material as to determine just how much the Survey can afford to pay those who have

developed to mature ability in its service. In many cases only salaries approaching the worth of their expert knowledge in the open market will suffice to hold them at Washington. The work of the Survey is important to the mining industry and we hope that such appropriations may be made by Congress as will enable the Director to maintain his staff.

LAST week the San Francisco section of the Institute had the pleasure of meeting and hearing the president, Mr. Horace V. Winchell, and the secretary, Mr. Bradley Stoughton. It was much the most pleasant of such affairs during recent years. Mr. F. W. Bradley, chairman of the local section, steered the proceedings pleasantly and himself made some interesting observations concerning the status of the engineer in society. Mr. Winchell told the members about his visits to other sections and touched upon the many useful activities of the Institute. He referred to the coal strike and to the intermittency of operations in the bituminous industry, decreasing the working-time of labor and rendering an enormous capital unproductive during a large part of the year. The shipment of coal during winter was another form of waste; he instanced a train of 154 cars of coal that went from Duluth to Butte and encountered weather so cold, accompanied by such delays in travel, that 52 carloads of coal were consumed in the boilers of the locomotives during the journey. He described how the mining profession was co-operating with officials of the Treasury in adjusting the tax-valuation of mining enterprises. Mines pay 250 million dollars as income-tax and 35,000 financial statements from them are now under examination. A licensing law for engineers has been introduced in many States; in numerous instances it has been modified so as to prevent injurious restrictions; in Idaho the law is limited to civil engineers, who are defined as "not military, mining, or metallurgical"—this being a new and amusing definition of an old professional term. Mr. Stoughton's most interesting statement referred to the American Association of Engineers, the young and assertive organization at Chicago. The secretary of the Association, Mr. C. E. Drayer, met the secretaries of the four founder societies in conference at New York on December 8, on which occasion he suggested that as the Association engaged itself chiefly in welfare, not technical, work, it would be well to arrange a plan to avoid rivalry and promote co-operation. He was told, as Mr. Stoughton said, that "co-operation was our middle name", that the new organization was quite welcome to do its share of technical work, but, that, on the other hand, the older societies could not think of abandoning welfare work, which was one of their recognized functions. Mr. Drayer then suggested that the older societies drop their employment agencies, because his organization was attending to that most effectively. On this Mr. Stoughton remarked that while 'The Monad', which is the Association's mouth-organ, shows that 2985 men were helped to appointments during the previous three months, whereas the employment offices

of the four older societies had helped 5909 in a similar way during the same period. It was agreed that the secretaries of the societies would co-operate with the secretary of the Association and the meeting ended with expressions of good-will. This is seasonable, but to us it is evident that keen rivalry exists between the new organization and the older ones; nor will it prove injurious; on the contrary, we think that the older institutions will be stirred to new life and greater usefulness. During his term of office Mr. Winchell has proved a most efficient president, devoting a large share of his time to his duties in such a way as to give increased scope and greater purpose to the activities of the Institute. He will be succeeded by Mr. Hoover, who, as president, undoubtedly will bring the profession into a larger measure of national prominence and social usefulness.

AMONG the items of mining news from London we note that the Mysore Gold Mining Company, the parent enterprise of the Kolar goldfield in India, is to make a new issue of capital in order "to initiate a vigorous policy of exploration and development work". This is to be done by creating 610,000 additional shares of 10 shillings each, thereby doubling the existing capital of the company. The management acknowledges the adverse conditions it has had to face during the past four years, which have compelled a curtailment of exploratory work, thereby diminishing the tonnage of ore in reserve. The circular says: "In its long and remarkable history of prosperity, the Mysore mine has from time to time encountered zones of impoverishment which in due course have again given place to high-grade ore. For some time past the deeper levels of the mine have shown a repetition of the variableness of quartz reef mining and have been producing ore of lower grade, while the reef has been of less width than in the upper levels." This is a belated acknowledgment of facts known to those who have followed the course of gold mining in the Kolar district; it is a recognition of conditions that should have been faced many years ago. The management and the shareholders of the Indian mines have been fooling themselves for at least five years, if not for ten, with the idea that their mines were not subject to the general experience of impoverishment in depth. In our issue of December 19, 1914, we published an article by the present writer, on 'Persistence of Ore at Kolar', this being an excerpt from a paper read before the Institution of Mining and Metallurgy, in London, in the course of which the general non-persistence of ore was discussed exhaustively. It was pointed out then that the ore in the Mysore and neighboring mines occurred in well-defined shoots having a pitch of about 45° northward. As the Mysore is the most southern of the group of four rich mines, it has not benefited as much as the Champion Reef, for example, by the incoming of ore-shoots pitching into its ground from its southern neighbor. The talk of "zones of impoverishment" is misleading because the simpler and truer explanation is the recurrence of definite shoots pitching regularly at a

high angle, so that the workings in depth pass through alternations of productive and unproductive ground. As no important ore-shoots have been found south of the Mysore property, there is no reason, only a vague hope, for expecting that a vertical extension of the workings will cut new orebodies. The real condition of the mine has been obscured by drawing upon ore held in reserve in the upper workings and by stating the tonnage available without giving either its grade or its distribution; in other words, the depth of the mine in any year has borne no direct relation to the quality of its output. Again, for the nth time, the managers of mines are brought to account for failing to recognize a generalization based upon the world-wide experience of mining, namely, that mines eventually become poor in depth as surely as men are enfeebled by age.

Mr. Hoover on National Economics

Everybody ought to read the article entitled 'Some Notes on Industrial Readjustment', by Mr. Herbert Hoover in the 'Saturday Evening Post' of December 27. The paper founded by Benjamin Franklin publishes a good deal of second-rate stuff, and as a journal of opinion it suffers from the fact that it goes to press about a couple of months before it is cut into weekly instalments, but on this occasion it has scored tremendously by giving the public an article of commanding interest written by the man of the hour. In making this pronouncement of economic policy Mr. Hoover has behind him five years of vital contact with international affairs on the largest possible scale, as well as his career as a mining engineer, during which he had to deal at first hand with the employment of labor and capital in many countries. He has the knowledge and the sympathy required to discuss basic problems of economic policy from the American standpoint; for there is no mistaking the fact that he writes in terms of Americanism, not Americanitis, which is only a pitiful provincialism masquerading as patriotism. His chief plank is the social philosophy that has been developed by the United States during its 150 years of progressive life, namely, "an equality of opportunity—an equal chance—to every citizen". In the following summary of Mr. Hoover's article, we shall quote him nearly verbatim, omitting quotation marks only in order not to interrupt attention. Our society is not a stratification of classes, it is a virile mass, stimulated by competition. We have no frozen class distinctions; the assumption of such distinctions between labor, capital, and the public is the expression of a false kind of class consciousness, which threatens to build for us the same kind of foundations as those upon which Europe rocks today. In order to consider industrial problems intelligently we must have not only a social ideal but an understanding of the economic factors that will contribute to that ideal. The economic forces cannot be divorced from the social, for we deal with human beings, not the "economic man" of the old textbooks. The primary purpose of our national policy is to improve the standard of living of all

our people; that standard of living is the direct quotient of the amount of commodities and service that are available for the whole population. The human animal labors under the major impulse of securing for himself a direct share of these commodities and services; his minor impulse is the joy of craftsmanship and the spirit of duty to the community. The infinite variety of hand and brain can find its maximum development only through the stress of competition. The hope of an unusual return is the spur to unusual activity. The illegitimate division of the surplus is the real cause of quarrel, but the surplus is so small a part of our production that it is possible to stifle the increase of capital by over-payment of wages, or to stifle labor by allowing too great a profit to capital; either extreme will ultimately curtail production or savings, and bring misery upon the entire community. The organization of trades-unions is a safeguard for equality of opportunity, and the recognition of the right to combine cannot be separated from the right to bargain collectively; nor can this principle be accepted wholeheartedly without acknowledging the right of the unions to call men skilled in negotiation to assist them in such bargaining. Any form of combination can be perverted for the purpose of dominating the community; if it is used to dictate social and political measures to the community it is violating the foundations of rule by the majority through representative institutions; when it is used to limit the effort of individual workers or to prevent others from working, it is a violation of community rights and a negation of equality of opportunity. The combination of capital is likewise economically sound up to the point where overgrowth leads to such an excess of bureaucratic administration as to cause inefficiency. The moment such combinations begin to dominate the community, either in wages or prices or production, or to check healthy competition, they violate the primary principle of equality of opportunity. One remedy is to extend the anti-trust laws so as to place such super-combinations under government control as soon as their operations pass a certain proportion of the national production. Nationalization of industry fails by destroying the impulses that create efficiency and the initiative that is necessary to improvement. No scheme based upon political appointment has developed an acceptable alternative to competition as a means for selecting men of ability and character. Under government bureaucracy the only safeguard against graft and favoritism is promotion by seniority, which kills initiative and extinguishes the advantage of extra ability. The price we pay for free play of opportunity is an excess of gain to sundry individuals. The atrocity of such gains out of the misery of a nation at war is unbearable. The inheritance, income, and excess-profit taxes tend to a better distribution of wealth, but the use of excess-profit taxes to remedy an unfair distribution, or even for revenue, discourages initiative and stimulates waste, contributing thereby to the high cost of living. Co-operation in production between capital and labor suffers from the increase in the size of industrial units, because this leads

to such specialization and repetition, and such remoteness of contact between manager and men, as to destroy the mutual responsibility that exists in smaller units. Any effort to promote co-operation will fail if it involves the unscrupulous use of piecework or an attempt to lower wages by scaling down from the most skilled instead of up from the least skilled. On the other hand, if union labor would adopt the idea of maximum effort and skill on the part of each worker, and the sharing of the result with the employer, then the larger part of the friction in obtaining its other objectives—conditions, hours, remuneration—would disappear. Some kinds of speculation are inevitable, but the individual who injects himself into the normal flow of commodities between the stages of distribution is poaching upon the community and returning no service for the toll he takes. So is the gambler on the stock exchange. Finally, until the Government abandons its method of war finance by way of gigantic inflation of credit, and consequent incitement to speculation, there will be little relief from profiteering and its bitter sequel of a high cost of living. We hope that this summary will cause our readers to study the original text and obtain the full benefit of the article, which, as we have said, presents in succinct form an economic policy acceptable to all good citizens. It is worthy of Mr. Hoover's reputation. In the same issue, the editor of the 'Saturday Evening Post' makes an attack on politicians, which may be justified by conditions at Washington, but is couched in terms so blatant and vulgar as to repel even those in agreement with his main argument, which is that we are in urgent need of relief from petty politics. It looks as if the editorial were meant to direct attention to a man of unconventional abilities and free from the faults against which it rails, but we question whether Mr. Hoover wants or needs such advocacy. His acts and utterances speak for themselves.

Let Us Have Peace

The artificial division of time invests the first day of January with sentiment; it serves to punctuate the periods of life, and halt the heedless progression of human thought. It is a day for taking stock of the morrow; whither are we voyaging and how stands the barometer? Let us confess that 1919 has been a great disappointment to the idealist and the optimist, to men of liberal thought and hopeful vision. When the Armistice was signed near the end of 1918 and peace was promised at an early date, we looked to 1919 to redress the disordered balance of the world and to heal the hurts of the great conflict. We looked forward to a period of reconstruction in our country and of rehabilitation in those devastated by war. 1919 failed to fulfill its promise. Much of Europe remains distracted and unorganized, famine and pestilence stalk in the wake of the grim spectre of war, the Russian cesspool corrupts the air of three continents, the treaty of peace is not signed, the covenant of the League of Nations has been rejected, and even the nations that were allied in battle have so lost their feeling of comradeship that they suspect each

other almost as much as their unrepentant foe. It is a miserable ending to a black chapter in human history. Evidently a great mistake was made. The Armistice came too soon. It were better to have continued the fighting long enough to have finished the task of conquering the Germans in battle and then treating them generously, instead of leaving the military task unfinished, so that it had to be supplemented, after the Armistice, by an economic blockade and other reprisals. "The world has had a great fright," as Mr. Lloyd George said, and in its fright it took a number of precautions that reflected the distrust of mankind and the apprehensions of the allied nations so thoroughly as to undermine the foundations for peace. It would have been better, as we see it now, to have finished the War and foregone the demands for punitive justice; to have ended the economic blockade and abstained from penalizing unborn generations; to have made a generous gesture and allowed the Enemy all the help he needed to regain a healthful natural life; to have called for the aid of all, conquered as well as conquerors, in a united effort to bring order out of chaos and economic stability out of internecine strife. The end of the year finds civilized mankind in a mean mood, suspicious, jealous, greedy, and quarrelsome. The message of Bethlehem sounds as foreign as Aramaic; a snarling as from the jungle gives a hideous undertone to current controversy. Only one remedy is evident, and that is to make an end of the existing warfare of mind by concluding a peace such as will hasten a restoration of international relations and thaw the frozen arteries of trade. We are not surprised that a body of men so sagacious as the New York Chamber of Commerce passed a resolution demanding peace, even if "it necessarily involves some sacrifice of long-cherished precedents and practices". They say: "We want it speedily; but we want an honorable peace. Many parts of Europe are in desperate plight. A peace in which we wrap ourselves in the robes of isolation and self-interest would be as dishonorable as further delay would have been in our decision to enter the War on April 6, 1917." It is folly to continue talking, whether at Washington or elsewhere, while the complex organism of civilization is breaking to pieces. We have been warned, by Mr. Hoover and others, of an industrial collapse, at home and abroad, if international trade continues to suffer check by reason of delay in reconstructive work. The present condition of international exchange is eloquent to those who understand its meaning. You can smuggle against an embargo or a tariff, but not against an unfavorable rate of exchange; that kills business with other countries. The failure to conclude peace is not only withholding the essentials of reconstruction from the European peoples, but it is threatening increasingly to congest our production and aggravate the domestic difficulties arising from our recent state of war. The time has passed for sacrificing this great issue to the play of partisan politics; in the name of a common humanity and an enlightened national spirit, let us have peace!

The Bunker Hill Enterprise—I

A Historical Retrospect: The Oregon Territory and Early Exploration

By T. A. RICKARD

The chief lure to exploration in the south and south-west of the American continent was the miner's search for the precious metals; in the north and north-west the trade in furs took the hunter into the primeval wilderness. The Spaniard pushed his conquest into the mountains of the tropics, seeking gold and silver, while the Briton and the Frenchman invaded the Arctic in eager competition for the rich peltries of the snowy regions. It was the fur trade that sustained the earliest Canadian settlements and caused the French to penetrate the vast hinterland to the west of them. They were followed by the agents of British merchants in New York; and after the British colonists south of Canada had won their independence, the American trader joined in the quest, each in turn striving to reach beyond the others into fresh preserves and to do business with the aborigines that roamed over them, until, at least, these westward trails of adventure dipped into the Pacific Ocean.

A few dates will recall the springs of American civilization. Columbus discovered the new world in 1492; Ponce de Leon explored Florida in 1512; Cortez placed his mailed fist on Mexico in 1520. All these sailed under the flag of Spain. The fisheries of Newfoundland were exploited by the Bretons and Basques at least as early as 1504¹; Verrazano entered the bay of New York in 1524; Jacques Cartier sailed up the St. Lawrence, as far as the present site of Montreal, in 1534. These were Frenchmen. Henry Cabot made the first landing upon the American mainland in 1497; Raleigh attempted to colonize Virginia in 1585; in 1607 John Smith founded Jamestown; in 1620 the Pilgrims disembarked from the 'Mayflower' on Plymouth rock. These sailed under the English flag, and planted their ideals of liberty on the soil of America.

Some of the first settlers were seeking to escape from tyranny in Europe, but many of the early sailors and explorers who crossed the Atlantic were looking for fabled mines of gold and silver, of which they had heard from the aborigines. After Cortez and Pizarro broke into the natural treasure-vaults of Mexico and Peru the idea of finding metallic wealth in other regions became firmly established. The tales of El Dorado, the gilded man, and of Cibola, the seven cities of untold riches, fevered the imagination of the first European adventurers. The gilded man proved a myth that arose from the swamps of Venezuela, and the seven cities were found at last to be no better than adobe dwellings in the desert

of Arizona. The visions of finding hoards of precious metal had their day in stimulating the pioneers of civilization in the north as well as in the south, but the recognition of the wealth to be derived from the trade in furs in the northern parts of America became general at the close of the 17th century and thenceforward served as a spur to discovery and exploration into the background of the coastal colonies.

Competition in the fur trade at first was unrestricted by treaties or territorial limitations, and culminated therefore, as was to be expected, in disputes that left their mark on the map of North America. I shall attempt a brief review of the history of commercial expansion in the North-West, because upon it was founded the migration on which the country depended for its industrial development², more particularly the development of its mining industry and the eventual discovery of the ore deposit that became the basis of the important mining enterprise to which this series of articles will be devoted.

The earliest curiosity concerning the north-western part of this continent was aroused by the idea of finding a way from Europe to India. The fable of a supposed transcontinental water-way, called the Strait of Anian, enticed the Spanish pioneers northward from Mexico, as the similar tale of a Northwest Passage took the English navigators into the Arctic ice. Cabrillo sailed up the Pacific coast from Mexico to San Diego in 1542; Drake voyaged as far as Vancouver island in 1558; Portola discovered the Bay of San Francisco in 1769; Perez in 1775 went to where Sitka is now; and Cook, in 1778, on his last voyage, reached the Alaskan coast from Hawaii.

The Spaniards established themselves in northern California in 1770, and shortly afterward claimed the entire Pacific coast as their own, but English and Russian fur-trading vessels began to come around Cape Horn in order to barter with the Indians, and the English even made a tentative settlement at Nootka, on Vancouver island. The Russians had discovered Alaska in 1741, when Alexis Chirikoff, sailing from Kamchatka, anchored in Cross Sound, and returned to the Asiatic mainland with a fine assortment of furs. Soon trade was established with the Aleuts, and the *promishlenniki*, or fur-traders, came regularly from Siberia to hunt the sea-

¹'Pioneers of France in the New World', by Francis Parkman.

²It is noteworthy that at this time the fur business, which led to the early development of the Oregon territory, is the liveliest industry in the Yukon and Alaska on account of the appreciation in the value of furs and the depreciation of gold.

otter. In 1783 Shilikoff erected a factory on Kadiak island and in 1799 the Czar Paul gave control of the Alaskan colony to the fur-traders doing business under the name of the Russian-American Company. Conflict between them and the English did not mature until later, but the dispute between Spain and England was adjusted in 1789, when Spain agreed not to extend her claims farther north than latitude 42°N. , which is the present northern limit of California. On May 11, 1792, Capt. Robert Gray, commanding the 'Columbia', entered the mouth of a great river in latitude $46^{\circ}19'$ north and named it after his gallant ship. The natives thought the ship was a floating island; they feared that the landing crew were cannibals, but, as they were well treated, they proved friendly. On putting out to sea, Gray fell in with Vancouver and told him about the great river, furnishing him with a chart of the entrance. Vancouver explored it, and his lieutenant, Broughton, ascended the river more than a hundred miles, getting a sight of a snowy peak, which he named Mount Hood.

Meanwhile hunters and explorers from the Atlantic seaboard were endeavoring to cross the continent and establish communication with the Pacific coast. The French *voyageurs*, or professional carriers and canoe-men, and their comrades the *coureurs des bois*, or rangers of the woods, were the leaders in penetrating the interior in furtherance of their trade with the Indians. At first the fur trade was conducted chiefly along the lower St. Lawrence and the Saguenay rivers; later, the Ottawa and the Great Lakes proved more productive and made Montreal the great market for furs. In 1615 Champlain reached Lake Huron and Lake Nipissing. In 1670 the Hudson's Bay Company, an English enterprise organized by Prince Rupert "and seventeen other nobles and gentlemen", under charter from Charles II, was given exclusive privilege over the back country, and "the Governor and Company of Adventurers of England trading into Hudson's Bay" began their career of commercial expansion westward. The French had broken the furrow, but the British conquest of Canada in 1762 prevented them from reaping their harvest. During the wars between England and France, the agents of the Hudson's Bay Company were much harassed by the attacks made upon their posts by the French, but these depredations ended with the cession of Canada to Great Britain in 1763. The fur business began to attract many, and fierce competition ensued, resulting in the wasting of merchandise and credit in unscrupulous dealings with the natives. The Indians were debauched by the sale of spirituous liquors and their respect for the white man was undermined by bloody feuds between rival parties of fur-hunters, who turned the trade into lawless confusion. To correct some of these evils, the Northwest Fur Company of Montreal was formed in 1787. The agents of this company, like those of the Hudson's Bay Company, were mostly Scots of thrifty habit and hardy physique. Their names are to be found all over the map; the frequent 'Mac' reminding us of the dour forerunners of civilization in the days when the Highlander held

sway over the lakes and forests of western and northern Canada. The reduction of competition to the Hudson's Bay and the Northwest companies served to restore some measure of dignity and decency to the fur trade. The success of these enterprises led to the starting of others, such as the Mackinaw company, which pushed its way south-westward into what is now United States territory.

In 1754 the French explorer De la Vérendrye got as far as the Yellowstone. Many efforts were made to cross the continent: by John Ledyard in 1788, by John Armstrong in 1790, and by André Michaux in 1792. These failed, but on July 22, 1793, an intrepid Scot, Alexander Mackenzie, fortified by experience in north-western exploration and traveling by way of Lake Athabaska, the Peace river, and the Fraser, reached tidewater.

Then others came overland to share in the lucrative trade developed on the Pacific coast. Possession of the region now covered by Oregon, Washington, the southern part of British Columbia, and the northern part of Idaho, was contested by various claimants. By the treaty with France, in 1763, Great Britain had obtained control of the country west of the Mississippi, but the province of Louisiana, held first by Spain and then by France, extended into the vague remoteness of the North-West toward the Columbia watershed. In 1789, as we have seen, Spain limited her claims along the coast to a point 290 miles south of the mouth of that river, for the Spaniards had made no settlement and had obtained no foothold so far north. The Canadian fur companies sent their agents overland to trade with the Indians on the coast, and dealers from New England came in ships, around the Horn, to compete with them. Meanwhile the Russians were extending their trade southward from Alaska, and the Russian-American Company was claiming suzerainty over this *terra nullius*, by virtue of discovery and occupation southward, even below the mouth of the Columbia. In order to finish with the Russian participation in this boundary question, I shall anticipate by saying that in 1823 John Quincy Adams, Secretary of State, boldly controverted the Russian claims and in 1824 a treaty was signed limiting the Russian sphere of influence to north of $54^{\circ}40'$. Thus the Spanish, French, and Russian claims were eliminated, making room for the English-speaking peoples, for after 1783 there were two such peoples, which thereupon became rivals for the possession of 'Oregon', as the watershed of the Columbia was called in those days. See maps No. 1 and No. 2.*

The commercial activities of Canadian companies operating southward were noted by the government of the United States; the leaders of the new American nation looked askance at the growing influence acquired by foreigners over the aboriginal tribes within its own territories; therefore in 1796 an effort to counteract these activities was initiated by the American government and an attempt was made to establish rival trading-posts on the frontier, but unsuccessfully, because "the dull patronage of government failed to outvie the keen activity of

*These maps are reproduced from 'The Jefferson System', by Edward Channing.



MAP No. 1

private enterprise''.³ What the Government failed to do, the energy and enterprise of an individual succeeded in accomplishing. John Jacob Astor was the man. Astor was born in the German village of Waldorf, near Heidelberg, on the Rhine. He started his commercial career in London⁴, where he was living at the time of the American Revolution. In 1783 he determined to follow an elder brother, who had been residing in America for several years. The ship on which Astor sailed, together with a stock of merchandise into which he had put his savings, was detained by ice in Chesapeake bay, off Baltimore, and during the three months of inaction he became acquainted with a fellow-German who happened to be a furrier by trade. From him he obtained information concerning a business to which he had already been attracted by what he had heard about it. On arrival at New York, Astor sold his merchandise and invested the proceeds in furs, with which he returned from New York to London in 1784. He disposed of them satisfactorily and came back to New York the same year. Thereupon he devoted himself, perseveringly and thriftily, to his career as a fur-trader. He made visits to Montreal, where he made purchases of furs, shipping them direct from Canada to London, because until 1795 there were many restrictions upon trade between Canada and the United States. Immediately after a treaty had been signed, lifting these restrictions, Astor made a contract with the Northwest company, which established the first posts beyond the Rocky Mountains, north of the Columbia, in 1806. In 1807 Astor embarked in the trade on his own account, ceasing to be merely a broker or middle-man. He had now the capital and resources requisite, but he soon found that despite his knowledge and enterprise he could not overcome the opposition of the Mackinaw company, which controlled most of the trade within American territory. He appealed to the American government for help, offering to turn the whole business of that part of the continent into American channels. His plans were warmly approved at Washington. In 1809 he obtained a charter from the legislature of New York State incorporating the American Fur Company with a capital of \$1,000,000. This capital was furnished by Astor himself; in fact, he constituted the company. In 1811, in conjunction with certain partners of the Northwest company and others engaged in the fur trade, he bought out the Mackinaw company and merged it with the American Fur Company into a new association called the Southwest Company. This was done with the knowledge and approval of the American government. Unluckily the war of 1812 suspended the operations of the new company, and after the war it was dissolved, Congress having passed a law prohibiting British fur-traders from doing business within the territories of the United States.

During the time that Astor was building up his business overland from the Atlantic coast, others were pushing their way by sea, around Cape Horn, for the same

purpose, skirting the north-western rim of the continent from California to Alaska. In 1792 there were 21 vessels under different flags on the coast and trading with the natives. Many of these belonged to merchants of Boston. They would spend two summers on the coast, wintering in the Hawaiian islands,* and then sell their cargo of peltries in China, where they loaded themselves with tea, fabrics, and other merchandise, returning home after an absence of three years. Meanwhile the Russians had established permanent trading-posts on the Alaskan coast and among the Aleutian islands. China was then the great mart for furs and the Russians had the better access to the northern parts, where they were most in demand, whereas their American competitors had to sell at Canton, from which the furs had to be distributed northward. Among the American ships in the fur trade was the 'Columbia', commanded by Captain Gray of Boston, who discovered and named the great river, as we have seen.

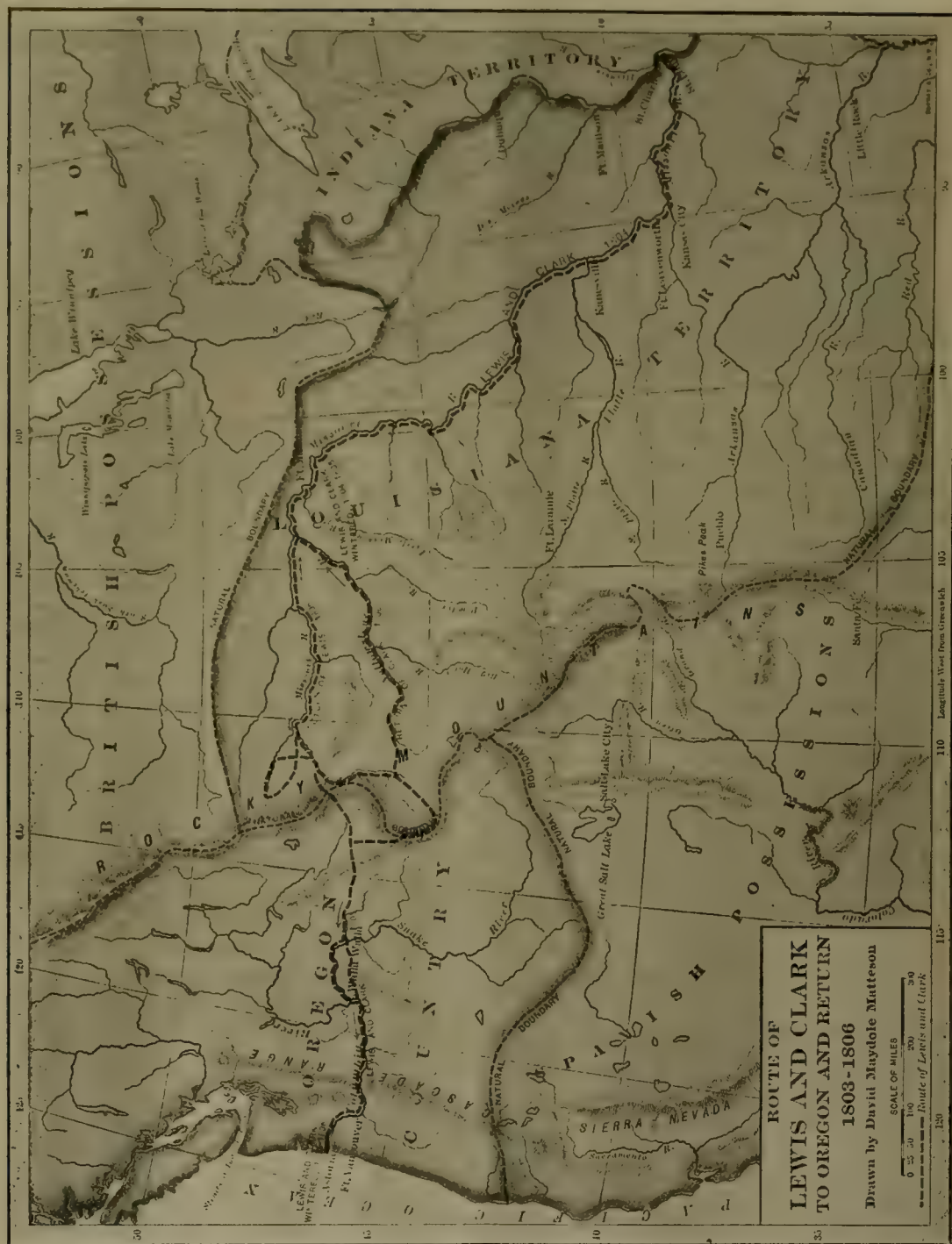
Then came the Louisiana purchase and the Lewis and Clark expedition, to which we must digress, leaving Astor for a while.

In 1803 the purchase of the immense territory called the Province of Louisiana was arranged between Thomas Jefferson, then President of the United States, and Napoleon Bonaparte, then First Consul of France. This central portion of what is now the United States was claimed in 1682 by the explorer La Salle for France, which continued to hold the title to this vast domain until 1762, when it passed by treaty to Spain, only to be ceded back to France in 1802, in consequence of Napoleon's military domination of Spain. Jefferson did not like to see New Orleans and its hinterland passing into the hands of France. Spain did not matter; she was quiet and feeble, whereas France was restless and aggressive under Napoleon, who had dreams of founding a French colonial empire on the American continent. Therefore Jefferson hinted at an alliance with England unless France ceded the region for an equivalent in money. The expression of American feeling that Jefferson elicited came as a surprise to Napoleon, who concluded that a contest was not worth while, for his navy had been shattered by England and it was evident that only maritime supremacy could serve to retain this trans-Atlantic colony; so he resolved to put it out of the grasp of England and at the same time replenish his military chest by selling Louisiana to the United States. The price was 60 million francs. Perhaps he had an idea that when he became master of the world he could compel a retrocession. The completion of the sale was facilitated by the house of Baring, in London, not without the cognizance of the British government, which was quite satisfied to see the transfer of the province from France to the United States. By the terms of this purchase a vast tract of land was added to the national domain; it covered more than a million square miles, or more than the total area of the United States at that time. Not only did it double the territory of the United States, but it gave to the United States indisputably the control of the western hemisphere. Louisiana

*Then known as the Sandwich islands.

³'Astoria', by Washington Irving.

⁴Where his great-grandson William Waldorf Astor died a British viscount on October 18, 1919.



MAP No. 2

included the present States of Louisiana, Arkansas, Missouri, Kansas, Iowa, Nebraska, South Dakota, North Dakota, Wyoming, Montana, Oklahoma, and parts of Minnesota, Colorado, and Idaho; but its limits northward were vague, so that historians do not agree as to the exact portion of country it embraced. For instance, it is not certain how much, if any, of Idaho was included. If it was limited to the watershed of the Mississippi, it would not include Idaho, which is drained by the Snake, the Salmon, and the Spokane, all of which are tributary to the Columbia river. At that time the entire population of this vast region, exclusive of the Indian tribes, consisted of 90,000 persons, of whom 40,000 were negro slaves. The white inhabitants were principally French.

In order to explore and investigate this new domain, President Jefferson, just before the actual transfer (on April 30, 1803), asked the Congress to appropriate \$2500 for an expedition, which was placed under the direction of Capt. Meriwether Lewis,* who chose Capt. William Clark as his chief assistant. This famous Lewis and Clark expedition consisted of 28 men, including the two leaders. Nine of them were young frontiersmen from Kentucky, 14 were soldiers from the U. S. Army, and two were French voyageurs.⁵ At that time the country beyond was quite unknown, weird tales were current concerning it, and when the explorers started to cross from the headwaters of the Missouri to the upper reaches of the then newly discovered Columbia, they were hardly expected to return. To show the vague notions in the mind of Jefferson as to the route likely to be taken on the return journey, it may be noted that in his instructions to Capt. Lewis he said: "Our consuls, Thomas Hewes, at Batavia, in Java, William Buchanan, in the Isles of France and Bourbon, and John Elmslie at the Cape of Good Hope, will be able to supply your necessities by drafts on us."⁶

The party set forth up the Missouri on May 21, 1804. They wintered on the north bank of the river opposite the spot on which years later Fort Clark was established in what is now McLean county, North Dakota. They ascended the Yellowstone and then the Jefferson. In August of the following year they entered what is now Idaho, reaching the junction of the Salmon and Lemhi rivers. In his journal Lewis speaks of the Shoshone Indians. He describes their migratory life, rendered necessary by search for food—salmon in summer and buffalo in winter—and their constant fights with the Pahkees, "the roving Indians of the Saskatchewan". He found them friendly, largely owing to his own considerate treatment of them. "The Shoshones are not only cheerful, but even gay; and their character, which is more interesting than that of any Indians we have seen, has in it much of the dignity of misfortune. In their intercourse with strangers they are frank and communicative; in their dealings they are perfectly fair; nor have we, during our stay with them, had any reason to suspect that

the display of all our new and valuable wealth has tempted them into a single act of dishonesty. While they have generally shared with us the little they possess, they have always abstained from begging anything from us. In their conduct towards us they have been kind and obliging; and though on one occasion they seemed willing to neglect us, yet we scarcely knew how to blame the treatment by which we were to suffer, when we recollected how few civilized chiefs would have hazarded the comforts or the subsistence of their people for the sake of a few strangers."

On August 30, 1805, the expedition started to cross the Bitter Root range. They "pushed on through the trackless wilderness, sometimes traveling on the snow that now covered the mountains". Soon all signs of game disappeared, so that, on September 14, "they were forced to kill a colt, their stock of animal food being exhausted. They pressed on, however, through a savage wilderness, having frequent need to recur to horse-flesh." Some of it was supplied by shooting wild horses, which had strayed from Indian camps. On September 20 the party "descended the last of the Bitter Root range and reached level country. They were at last over the Great Divide." Here they found some hospitable Indians and stayed with them several days. These Indians called themselves Chopunnish, or Pierced Noses, a name now commonly rendered *nez percés*, following the lead of the French voyageurs. However, it is recorded that these people, as far as known, did not pierce their noses. The expedition rested on the Kooskooskie (now the Clearwater) river, near the present site of Pierce City, at one time the county seat of Shoshone, the county in which is the great mine to which this writing is directed. Here they obtained information about the western watershed. The chief, named Twisted Hair, drew a chart of the river on a white elk-skin, explaining the relations of the Clearwater, the Snake, and the Columbia rivers. Having found a place where good timber was abundant, they started the building of boats. On October 8 the party set out in five canoes. They found the river full of rapids, so that progress was limited to 20 miles per day. At the confluence of the Clearwater and the Snake rivers they camped on the site of Lewiston, named after Captain Lewis. From this point they crossed into the present State of Washington. On October 17 they reached the 'Great River', as the Indians called it—the 'River of the North' or the 'Oregon', as the Columbia had been known to earlier explorers. On November 2 they reached tide-water and heard a few words of English from an Indian. In approaching the ocean they were exposed to a heavy storm, which fortunately they escaped by landing on the shore of Baker's bay on November 12. They had completed the crossing of the continent. On December 3 Captain Clark carved on the trunk of a big pine-tree this inscription:

"Wm. Clark December 3D 1805 by land from the
U. States in 1804 & 5."

On the return journey, in 1806, they made the crossing of the Bitter Root range with much less trouble, because

*Who was Jefferson's private secretary.

⁵'First Across the Continent', by Noah Brooks, 1912, page 7.

⁶Brooks, p. 13.



ASTORIA: GRAIN ELEVATOR AND WARSHIPS

the snow was hard enough to bear their horses and the fallen timber was so covered with snow as to obstruct them less, but the shortage of fodder compelled them to return to camp among their friends the Nez Percés in Quamash flats. On June 26 they made a fresh start and three days later they were out of the snow and fairly on their way into Montana, reaching the present site of Missoula on July 3. Four days later they went through the pass in the Rocky Mountains now named after them. On the plains they found themselves in the midst of great numbers of buffalo, so numerous that they seemed one immense herd. "Hanging on their flanks were wolves; hare and antelope were also abundant." On September 3 they reached St. Louis. "We arrived at 12 o'clock; and having fired a salute, went on shore and received the heartiest and most hospitable welcome from the whole village." So writes Capt. Lewis, who announced his arrival to the President in a letter dated September 23, 1806. Jefferson's reply was dated October 20, the difference in dates suggesting the slowness of the mail service in those days. In his letter the President expressed his "unspeakable joy" at their safe return.⁷ No news had

been received from the explorers for two years and four months. The first post-office in what is now the city of St. Louis was established in 1808 and mails between that "village" and the Atlantic seaboard required six weeks to pass either way.

Let me digress again for a moment. The search for the Northwest Passage yielded much knowledge concerning the navigable rivers of the American continent and opened the eyes of the explorers to the fur resources of the regions that they traversed. The rivers became the natural highways to the interior, and up them went the early colonists, the trapper and the trader leading the advance. Through the middle of the American continent, from the Arctic Ocean to the Gulf of Mexico, there runs

"Both these pathfinders were by birth Virginians. Lewis had been private secretary to Jefferson. After his return from the West in 1806, he was appointed Governor of Louisiana. He died by violence, mysteriously, in Tennessee on his way to Washington in 1809. Clark, on his return, was made Brigadier General and agent of Indian affairs. For seven years he was Governor of the Territory of Missouri. He died in 1838, at the age of 68, much respected.



GENERAL VIEW OF ASTORIA AND THE MOUTH OF THE COLUMBIA RIVER

a wide trough, which is crossed by the valley of the Great Lakes, on each side of which there is a low rim that separates the northern from the southern watersheds and the streams that once connected them. Short portages afforded the French voyageurs a method of linking the waterways north of the Great Lakes with those south of them: indeed in times of flood the connection was unbroken. Thus the French fur-traders, by adopting the use of the Indian canoe, paddled along a Canadian river into one of the lakes and across it, southward; then, carrying their boat for ten miles or less, they launched it on a stream that carried them into the tributaries of the Mississippi. The accompanying map shows these portages.⁸ After the Mississippi valley had been entered and colonized, the finger of exploration pointed westward, where the barrier of the Rocky Mountains intervened an imposing barrier to the migration of the people coming from the Atlantic coast. Again a river afforded a way of approach for the trapper and prospector. The Columbia throws mighty arms as far as the headwaters of the Athabasca in the north, and as far as the sources of the Platte and Colorado in the south; it penetrates the heart of the Rocky Mountains and almost touches fingers with streams that feed the Missouri. Lewis and Clark followed the Missouri and then its most westerly branch, the Yellowstone, to the mountain barrier, through which they penetrated by the Indian trail over the Lemhi pass, thereby reaching a branch of the Salmon river, which would have led them to the Snake and thence to the Columbia; but the Salmon was not navigable, so they turned northward over the range until they struck an upper branch of the Clearwater, down which they floated in their canoes first to the Snake and then into the Columbia itself, to the sea.

The movement of population from the eastern seaboard to the regions behind the Alleghanies began before the Declaration of Independence, but the Lewis and Clark expedition was the first to break through the barrier of the Rocky Mountains and start "the winning of the West."

Now we return to Astor. The reports published by Lewis and Clark showed him the practicability of maintaining a line of communication across the continent. He decided to establish trading-posts along the Missouri and the Columbia, with others between. As the mouth of the Columbia he would have his chief establishment and to it he would send a ship each year from New York with supplies and merchandise suited to the trade with the Indians. He submitted his scheme to Jefferson, who gave it his warm approval, because the President foresaw that it would facilitate the spreading of the American people toward the Pacific Coast and thereby promote the growth of the nation. With the approval of the Government, Astor organized two expeditions, one by land, under Wilson Price Hunt, of New Jersey, and another by sea, to go around the Horn to the mouth of the Columbia. For this he provided the 'Tonquin', a ship of 290 tons burden, mounting 10 guns, and with a crew of 20 men. She carried a varied assortment of merchandise, including seeds.

The captain was Jonathan Thorn and with him went Alexander McKay, Duncan McDougal, and David Stuart, these three being former agents of the Northwest company who had been taken into partnership. A number of clerks and artisans, besides 13 Canadian voyageurs, were included in the expedition.

On September 8, 1810, the 'Tonquin' set sail. The ship's company did not behave well and caused the Captain much trouble, disobeying his orders and prompting him to be unnecessarily harsh, besides quarreling among themselves. On Christmas Day the 'Tonquin' doubled Cape Horn. Early in February she anchored off the island of Owyhee, one of the Hawaiian group, then called the Sandwich islands. There the members of the expedition rested for 16 days. On March 22 they arrived at the mouth of the Columbia, where they had trouble in landing, eight men being lost in the first attempt. The 'Tonquin' anchored in Baker's bay, as the Lewis and Clark expedition had done. A site for the trading-house was selected near Point George and was named 'Astoria'. On June 5, 1811, the 'Tonquin' was sent up the coast with 23 persons on board, under Captain Thorn. Off Vancouver island he got into a quarrel with the Indians, who then, under cover of trading, swarmed on board, killing most of the white men, the survivors blowing up the ship and taking more than a hundred Indians with them to death. The news of this loss struck dismay in the hearts of the pioneers at Astoria, but they kept a brave heart and proceeded energetically to build their trading-house, a commodious mansion completed on September 16, 1811. They were awaiting the arrival of the party under Hunt.

In July 1810 Hunt started from Montreal, where he had equipped his expedition, and on July 22 he reached Mackinaw, the old French trading-post on the island of that name at the junction of lakes Huron and Michigan. There he recruited voyageurs. On August 12 the expedition started for St. Louis, arriving on September 3. St. Louis had grown now to a considerable frontier settlement and served as the last outfitting depot for the Indian trade of the West. On October 23 Hunt set forth in three boats up the Mississippi and thence 450 miles up the Missouri to the mouth of the Nodowa (or Nodaway), which he reached on November 16. Opposition from the Missouri Fur Company delayed him repeatedly. He did not resume his advance until April 28. Then he crossed the Black Hills of South Dakota and the Bighorn range of the Rocky Mountains. On September 24 he reached one of the streams tributary to the Columbia and came within sight of the Three Titans. The party crossed the desert that stretches between the Snake and the Columbia rivers. By this time they were short of food and suffering from hardships. It was December, and the snow impeded them in crossing the mountains. They lived on the flesh of horses captured from the Shoshone Indians. A milder climate and plenty of food gladdened them when they reached the Umatilla. On January 31, 1813, Hunt reached the falls of the Columbia and on February 15 he arrived at Astoria, after 11 months of wandering across the wilderness. The distance he and his party had

⁸'American History and Its Geographic Conditions', by Ellen Churchill Semple. Page 28.

traveled, from St. Louis to Astoria, was 3500 miles, although in a direct line it is only 1800 miles.

The news of the outbreak of war between Great Britain and the United States had reached Astoria, by sea, on January 15, 1813. On October 16 there appeared a vessel with agents of the Northwest company on board. These contracted for the purchase of the American company's property—"establishments, furs, and stock in hand"—for \$58,000. Astor's local representatives were largely Canadians with a friendly feeling toward the Northwest company. While the transfer was being concluded a British sloop of war arrived with orders to capture Astoria. The sale having been made, its terms were respected. "The American flag was replaced by the Brit-

Thompson, of the Northwest company, had tried to forestall Hunt's party, representing Astor's company, but he had been delayed in crossing the mountains. Nevertheless he laid claim to various points as he descended the Columbia and erected flagstaves flying the British colors. On this performance the British government based its claim to suzerainty in 1826. This corner of the continent continued to be a disputed territory, but the establishment of the northern border of the United States was under way. Russian control on the Pacific coast had been fixed at 54°40' north and Spanish, or Mexican, rule at 42°, leaving an interval of nearly 13 degrees, equal to 900 miles. There remained the conflict with Great Britain. In 1826 the 49th parallel of latitude was accepted tem-



PORTAGES BETWEEN THE GREAT LAKES AND THE MISSISSIPPI

ish, and Astoria was re-christened Fort George.¹⁰ The touch of military conquest given to the affair, by the presence of the British warship, caused the restoration of Astoria to the United States under the Treaty of Ghent in 1818, but it was held by the Northwest Fur Co. until 1821, when it passed with other possessions of that company into the hands of the Hudson's Bay Company.

For ten years after the capture of Astoria, scarcely an American was to be seen in this region. An agreement for joint occupation was made in 1818 between the United States and Great Britain, but this failed to decide the opposing claims and only served to accentuate the conflict of interests. The agreement that this region should be open to the inhabitants of both nations was for ten years, and in 1828 it was extended for ten years more. The Hudson's Bay Co. extended its posts; the Columbia River basin was occupied by British subjects and governed under British law. In the spring of 1811 David

porarily by both parties as the frontier up to the Rocky Mountains. Interest in the subject grew to excitement as migration over the Oregon trail increased. In 1843 an expedition of 1000 persons, including women and children, with herds of cattle and horses, trekked from Missouri to the valleys of the Willamette and Columbia. In 1844 another 2000 emigrants of like character joined them, and in the following year 3000 more. The Hudson's Bay agents objected to this peaceful invasion because it spoiled their hunting-grounds. Congress was slow to act, but, thanks to the exertions of Senator Thomas H. Benton, a treaty was concluded amicably in 1846, the British protocol being accepted, whereby "the Oregon territory was divided by the 49th parallel from the Rockies to the Straits of Fuca, and thence by a line following the main channel of these straits to the sea".¹⁰ Two years later, in 1848, Oregon was created a Territory.

¹⁰'A Brief History of Rocky Mountain Exploration', by Reuben Gold Thwaites. Page 196.

¹⁰'The Winning of the Far West', by Robert McNutt McElvay. Page 127.

(To be continued)

A Contribution to the Study of Flotation—I

By H. LIVINGSTONE SULMAN

*As one of those who, in 1905, were concerned in the discovery of the essential facts on which modern flotation is based, the author submits the following paper on the principles underlying what is now recognized practice.

Some of the earlier attempts to explain flotation will not bear close scrutiny; this is hardly to be wondered at in a subject whose facts even now lie so close to the border-line of our knowledge. On the other hand, many of the phenomena involved have received mathematical treatment too abstruse for the needs of the working metallurgist, who in turn has accumulated facts and an empirical knowledge of conditions often unknown to the mathematician. In this paper an endeavor is made to link-up and explain the complex of facts, in simple non-mathematical language, upon the broad lines of the molecular hypothesis, to the exclusion of operative detail.

In some quarters adverse criticism has been levelled against the original patentees of the froth-flotation process on account of the delay in publishing their experience and knowledge for the benefit of the industry; but this inaction was forced upon them and the owning company (Minerals Separation, Ltd.) by the litigation in which they have been involved almost continuously during the past 14 years.

The term 'flotation' is now narrowed in practice to ore-concentration processes wherein metallic sulphide or other particles suspended in an aqueous ore-pulp are recovered therefrom in an air-bubble froth. A short time since this method was more closely defined as 'froth-flotation' or the 'agitation-froth process' in order to distinguish it from other forms of float-concentration which employed other buoyant means; also from 'film' processes and from methods of oil-adhesion not involving buoyancy.

Such other processes may conveniently be grouped under the following heads:

(1) Those utilizing surface-tension effect at a water surface, or filming processes; such as De Bavay, Bradford, and MacQuisten.

(2) Methods where oil is employed both as the adhesive and the buoyant medium for the particles separated, or 'oil-buoyancy' processes. These include the use of a mass of oil, as in the Elmore bulk-oil process; in such the buoyant effect of the oil may be increased by the inclusion of some air-bubbles, oil-coated sawdust, or the like.

(3) Methods depending on the adhesion between oil or grease and the separable particles but not on final recovery by flotation, termed 'adhesion' processes, such as

the grease-plate, oiled-band, Murex, Cattermole, and similar methods.

(4) Processes where a mineral froth is produced through the agency of gases other than air, generated by chemical reactions, in which the minerals may sometimes take part; such as Potter, Delprat, and Froment.

(5) The Elmore vacuum process, and 'plus-pressure' methods, where air-bubbles are generated upon mineral and oiled particles by the aid of pressure differences.

The above classification is but a rough one, as connecting links exist between processes included in more than one of these classes; closer definition, however, would involve needless elaboration. Thus oil has been used in filming methods; oil-flotation has been employed to save metal suspensions not associated with gangue; and although in theory oil is not essential for froth-flotation, in minute amount it is still employed as a useful, if not integral, addition. No appraisalment of the respective merits of any of these processes is attempted or intended.

Nearly all sulphide ores, as well as those in which native metals and non-metals (sulphur and graphite) occur in practicable amounts, are amenable to concentration by flotation. Owing to the simplicity and economy of the operation and its ability to recover slimed mineral, flotation has rendered profitable the exploitation of many hitherto valueless ores; thus a deposit of a sulphide ore containing only 0.8% copper with but small silver values is now being treated profitably. The same factors greatly increase the returns of many productive mines; it is computed that the method now deals with about 60,000,000 tons of ore annually.

Originally thought to be applicable only to the types of ore above-mentioned, experience has shown froth-flotation to have a much wider field. Oxidized ores of lead and copper (without the intervention of any 'sulphide-filming' process) are being treated commercially, while recent research has shown that other oxide minerals such as cassiterite may be flocculated and thereafter floated; even gangue-minerals betray distinct differences in their tendency to float or to remain wetted and sunken. Flocculation of a substance in the state of a true suspension is the step antecedent to its flotation, hence the problem in all cases is first to secure 'selective' or 'differential' flocculation of the mineral it is desired to float. With closer knowledge of the small yet often determinative margins of adhesion to water or other liquids which all varieties of minerals display, the possibilities of flotation promise enlargement in many directions, since any mineral flocculated can be froth-floated; the effective separation of this from other substances is conditional upon the retention of the latter as 'suspensoids' in water. As

*Abstract of a paper presented to the Institution of Mining & Metallurgy, in London, on November 20, 1919.

to cassiterite, continued investigations indicate its successful differentiation from the various accompanying gangue-minerals, and the advent of a commercial flotation process at no very distant date; it has even been found possible to separate barite from its associated gangue by differential flotation. Froth-flotation proves to have applications beyond those of metallurgy, and is already applied in certain branches of industrial chemistry.

When an aqueous ore-pulp is agitated with a minute quantity of oil or other 'reagent', its content of sulphide mineral is yielded as a coherent froth on ceasing the agitation. Having regard to the large volume of prior work in oil-flotation and filming methods it may seem strange that so apparently simple a method was not discovered before. The main reason would appear to have been the assumption that oil was the necessary flotation agent and not air; hence previous inventors used oil in excess of the extremely small amounts which were later found to limit and determine froth-flotation, any excess over such quantities being inimical thereto. Cattermole in his ingenious process for 'granulating' the sulphide minerals into small sunken shot-like agglomerates, separable from the unaffected gangue particles by gravity methods, was the first to reduce the oil to an amount small relatively to the mineral saved. Upon further reduction of the oil to an almost disappearing quantity, *and in the presence of an assemblage of finely divided air-bubbles*, the Cattermole phenomenon was found to be reversed; in place of forming shot-like agglomerates the mineral now rose in completeness to the surface, as a mineralized air-froth.

The method did not therefore arise from employing oil as the buoyant medium for mineral, since oil ceased to act as such when its volume becomes very small; a mineral-sinking stage is passed through before the proportion becomes sufficiently minute to permit the production of a froth. In 1903 a patent was filed† for separating mineral from an ore-pulp by sending through it a current of air-bubbles laden with the vapor or spray of oil. This method, however, did not lead to the production of a froth, nor to any practical results, as the other antecedent conditions essential for froth-formation had not at that time been ascertained; it is now known that to introduce a relatively substantial film of oil upon the interior of a bubble is to prejudice flotation of the mineral. It was also found that ore particles could be temporarily suspended in the froths yielded by aqueous solutions of amyl alcohol and other substances, not so readily in one of soap and not at all in those of saponin, ox-gall, or tannic acid; but for similar reasons these experiments were at that period unproductive of practical result.

It was not until later that the necessary minuteness of the oil amount was realized: indeed froth-flotation does not depend *essentially* upon the use of any oil whatever, as air-bubbles will readily adhere to metallic sulphide and other particles in its absence: oil, though a useful auxiliary, is neither causative nor a necessary inter-

mediary. Apart from the use of non-oily and completely soluble reagents such as cresol and amyl alcohol, a simple current of air-bubbles alone, passed through an aqueous ore-pulp, will yield practical flotation results. L. A. Wood devised a sub-aeration machine of this type which did excellent work, even of a 'differential' character. This is not surprising, since mineral particles of considerable size float freely by surface-tension, and many finely divided particles are absorbed at a plane water-surface which may be regarded but as a portion of a bubble of infinite diameter.

Prior to or shortly after Cattermole's invention, which in 1905 had been introduced on a commercial scale in Australia, a large amount of work had been done in 'oiling' or 'filming' processes. Several methods had achieved success, notably those of the Elmore (vacuum) process, plants for which were installed in various countries; of Potter, Delprat, and De Bavay, at Broken Hill, and others.

Froth-flotation was, therefore, the final link in a long chain of effort. All these methods were developed empirically, physical and chemical science having afforded little if any previsionary aid; success in every instance was attained by methods of patient trial. Science even yet is unable to offer a full explanation of all the facts involved, although the actual procedure is so simple, and the results so immediate, that at first sight an equally concise theory would seem possible.

The essentials of froth-flotation are that an aqueous ore-pulp, in general not less than four parts by weight of water to one of ore, shall be agitated for a longer or shorter period with certain reagents, which may conveniently be classified as follows:

(a) A froth-producing material, such as, cresol, amyl alcohol, the soluble portion of an oil: this by slightly reducing the surface-tension of the water permits the formation of an extensive bubble system, or froth, on the surfaces of which the mineral particles become attached or adsorbed.

(b) A froth-stabilizing substance, usually a minute amount of insoluble oil; this is adsorbed at the sulphide mineral surfaces and by increasing the water-mineral contact-angle stabilizes the composite froth to an extent greater than is possible with untreated particles. The oil-film on the floated mineral must be of ultra-microscopic tenuity.

(c) A gangue modifying addition (a mineral acid, alkali, certain alkaline or other salts, some sols), which acts by increasing the adhesion between the gangue particles and water; that is, intensifying the water-wetting effect and preventing their flotation by air.

Requirements (a) and (b) may be furnished by a single oil of a suitable character.

Thorough agitation of the ore-pulp with the reagents is necessary:

(1) To secure uniform suspension of all ore-particles in the water in order to ensure the maximum wetting effect possible at this stage, and to disseminate the frothing agent through the water;

†Sulman and Picard, No. 20,419, of 1903.

(2) To break-up and distribute the immiscible oil in order to permit the uniform coating of the sulphide particles with a film of ultra-microscopic thinness, a step akin to the prior temporary emulsification of the oil;

(3) To allow the modifying agent to deflocculate agglomerates of the particles it is not wished to float, and to free the more floatable particles from such agglomerates;

(4) To promote some degree of flocculation of the particles it is desired to float.

(5) The agitation system employed in the older 'standard' Minerals Separation system also serves to introduce the air into the ore-pulp, and there to break it up into minute bubbles, resembling an air-water emulsion. But if the first four of the above conditions are provided by the preliminary agitation, a certain time-factor being necessary, the air-bubbles may be produced otherwise and, as in sub-aeration apparatus, showered upward through the prepared pulp.

The explanation of flotation may be based on the differences shown by various substances in the degree to which they are 'wetted' by water or other liquids. Complete immersion of a solid in a liquid, even if the former be devoid of an actual or hypothetical air-film envelope and therefore involving actual contact, does not imply the complete wetting of one by the other, nor even that two different solids immersed in the same liquid will be wetted to a similar extent. On withdrawing the solid, it may, according to the nature of its surface (a property as inherent as its density, hardness, or color), tend to remain 'wet' in greater or less degree, or may apparently repel the moisture from its surface with less or greater rapidity and so become wholly or partly 'dry'. Wetting, which depends on the degree of adhesion established at the plane of contact between liquid and solid, is therefore a condition of wide variability, and a theory of flotation must be based largely upon the physics of wetting.

Substances capable of being wetted completely by any liquid, given sufficiently fine sub-divisions and neglecting effects due to differences in density, become true suspensions therein, that is, 'suspensoids' or possible 'sols'. The first tendency of such suspensions to become less completely wetted due to decreased adhesion between liquid and solid, is shown in the coagulation of sols and flocculation of suspensoids. When this step has been made, it is usually easy to take advantage of the decreased wetting and to enhance the 'drying' process by bringing a sufficient area of the solid into contact with air.

The particles may then appear to be thrust partly from the water into the air, either at a plane-water or a bubble surface, where they are held by the surface-tension of the liquid. The phenomena of flocculation, adsorption, and air-flotation are thus closely related stages in differential wetting, and the latter is at the root of all flotation phenomena.

The molecular principles involved will be reviewed briefly, but it may here be stated that the degree of wet-

ting may be influenced by the molecular porosity of the solid surface, and indicated more or less quantitatively by the 'contact-angle' made between the free surface of the liquid and the solid.

Such views supersede the previous ideas which endowed solids with specific 'surface-energies' supposedly capable of bringing about air or gas-condensations upon them in preference to liquid adhesions. Inasmuch as flotation effects were first observed to be pronounced in regard to many of the elementary solids, such as finely divided metals, the non-metals boron, carbon, silicon, sulphur, and selenium, and scarcely less so for metallic sulphides, most of these being substances of high chemical energy in relation, for example, to oxygen, the view was held that the chemical energy of the solid was reflected in a like surface-energy. We now know that where no actual chemical reaction is involved, the surface molecular-energy of any solid has little or no direct connection with the inter-atomic forces which constitute chemical activity. Moreover, the earlier theories did not account for all the facts, since an element of such low chemical activity as gold floats as readily as the more chemically energetic elements carbon and sulphur, and the various sulphides; further, completely oxidized compounds such as calcite, copper-carbonate, cassiterite, and several gangue-minerals can be floated almost as readily as the elements and sulphides. The surface-energy of solids, though as essential a factor in wetting phenomena as that of liquids, has nothing in common with the chemical activity of the solid.

Even in regard to the film-flotation of dense solids, erroneous ideas were prevalent; the particles were often thought to be borne in a depression of the resistant water surface as in a hammock, instead, in fact, of being suspended in the liquid, by the tension of the liquid surface.

The physical reactions concerned deal with molecular forces of high intensity, which act only over minute distances; it is necessary to examine these in some little detail.

Although the mathematical theory of surface-tension enunciated by Laplace remains of fundamental value, it is alone insufficient to account for an accumulation of newer facts. Laplace, who lived in the phlogiston era of chemistry, regarded solids and liquids as practically continuous media, their particles as stationary, existing in close contact without spatial divisions and devoid of the polarity which modern views on crystallography demand. He therefore treated of liquid and solid surfaces as mathematical planes; but the problems presented by colloid chemistry and physics, and the vast technical industries these affect (flotation may be regarded as one) are no longer explicable on this basis.

(To be continued)

AN ADVANCE STATEMENT by the U. S. Geological Survey gives the value of the mineral products of Alaska for 1919 as \$18,850,000. Gold produced is valued at \$9,000,000, and since 1880, when the mining industry began in Alaska, gold produced totals \$437,400,000.

Fine-Grinding in Ball-Mills

By HENRY HANSON

INTRODUCTION. The adoption of ball-mills as grinding-machines to reduce the ore of the Inspiration mine started a ball-mill wave that swept over every mining district of the country and from the time the Inspiration mill was put into successful operation there has been practically no new plants of importance in which some type of ball-mill or cylindrical mill, as a grinding-machine, has not found a place.

The great enthusiasm brought about by the simplicity

CRUSHING RESISTANCE OF DIFFERENT ORES. Some interesting work has been done by Luther Lenox of the Portland Mining Co. on the crushing resistance of various ores. Some time ago, when at Cripple Creek, it was my privilege to talk to Mr. Lenox about these experiments and to see the various screened products from these laboratory tests in glass bottles, whereby a graphic view was obtained of the crushing resistances offered by the different ores at the different stages of diminution. By

Results of Comparative Tests

Above 200-mesh		Below 200-mesh				Total mesh-tons		Comparative crushing resistance	Source of ore
Mesh-tons* × 100		Mesh-tons × 100		Mesh-tons × 100		Area P G A			
5 min.	10 min.	5 min.	10 min.	5 min.	10 min.	5 min.	10 min.		
8 150	13 850	2 120	5 080	6 960	12 520	17 230	31 850	18 470	1 00
9 810	16 550	5 080	13 400	13 400	23 850	28 890	53 800	24 540	0 75
								41 345	0 45

*The crushed ore between the designated limits of size, as shown on the graphs.

of ball-mill operation as signalized by the Marcy slogan "one easy step", for various reasons, has been somewhat dampened by the experience of the past four years in operating plants; first, it has been found that the big capacities promised on the soft Inspiration ore do not apply to the harder ores of other districts; secondly, in some instances where the ball-mill was installed to take a crusher-product, it has been found a decided advantage to break away from the "one easy step" and place cracking-rolls between the crusher and the bin supplying the ball-mill feed. Thus, by delivering to the ball-mills a much finer feed than the crusher-product, the capacity of the ball-mills has been greatly increased and the cost of crushing noticeably reduced; thirdly, the maintenance of the ball-mill has been much heavier than the earlier experience indicated. This, no doubt, is largely due to inferior manganese-steel being used in manufacture, owing to war conditions, and to the increased cost of these inferior products.

The ball-mill, however, is no longer an experimental machine. Its usefulness has been firmly established. In fact, the ball-mill may justly be termed a standard machine in all fine-crushing plants, but it has its limitation, and even now it would be ill-advised to install ball-mills on a large scale upon the basis of single or two-stage reduction without thorough preliminary experimental work to determine such problems as the capacity of the mill on the particular ore to be handled, as well as to ascertain the most suitable feed to deliver to the mill for the greatest economy in operation. It has been amply demonstrated during recent years that a ball-mill has not nearly as great a capacity when taking a crusher-product having a maximum size of 2½ inches as when taking a feed having a maximum size of one inch or one-quarter inch.

Mesh-tests on Above Ores After Grinding in Small Tube-Mill†

		Standard feed	New Cornelia		Inspiration	
		cumulative	5 min.	10 min.	5 min.	10 min.
On	10	12.95	1.47	0.38	1.28	0.33
"	14	27.98	3.06	0.82	3.44	0.70
"	20	39.47	6.12	1.08	5.01	1.01
"	28	49.88	10.60	1.45	8.25	1.21
"	35	57.11	17.67	2.11	13.76	1.50
"	48	63.01	28.87	4.91	23.84	2.56
"	65	68.71	39.81	13.95	34.20	7.55
"	100	74.01	51.24	30.33	45.31	19.42
"	150	79.69	60.38	44.38	53.66	31.65
"	200	82.41	69.05	50.10	62.08	46.49

†See Bulletin, A. I. M. E. August, 1918.

the courtesy of L. D. Ricketts, I was given the data showing the comparative crushing resistance of Inspiration, New Cornelia, and Portland ores, but before quoting this information, I want to state briefly how the data were obtained.

The grinding-machine used in the Lenox experiments was a cylindrical tube-mill, 8 inches in diameter by 12½ in. long. This mill was charged with about 7½ lb. of ¾-in. steel balls, one pound of ore, and an equal weight of water. The mill was revolved at a speed of 84 r.p.m. The feed to the mill in each case was identical as to screen-analysis, being artificially prepared from screened products. The period of grinding was five minutes on the first prepared charge of ore and ten minutes on the second prepared charge from each of the ores upon which the comparative tests were made.

After each of these grinding operations, the mill-charge was dried and a screen-analysis was made. The screen-analysis of the feed to the mills and the discharge from the mill after the five and ten-minute grinding-periods respectively, are shown on the accompanying tabulations, which also show the relative grinding-resistance of the Inspiration and New Cornelia ores. Sheet No. 1 shows the plotted curves on the plus 200-mesh. On Sheet No. 2, in addition to the curves of sheet No. 1, are plotted

the minus 200-mesh on a smaller scale to bring out the minus 200-mesh characteristics of the ore.

From the tabulated data using 1.00 as the grinding-resistance of the Portland ore, that of New Cornelia is 0.75 and that of Inspiration is 0.45, as shown on the tabulated data and plotted curves of Mr. Lenox's tests.

In Bulletin No. 140 of the American Institute of Mining Engineers, Mr. Lenox, in a splendid article on the 'Crushing-Resistance of Various Ores', shows the comparative crushing-resistance of 23 different ores tested in a way similar to that described above. Taking the Portland ore in these tests as having a crushing-resistance of 1.00, that of the Calumet & Hecla jig-tailing was 1.33, and that of the Ray Consolidated was 0.37. Of the 23 samples tested, the last two represent the two extremes. The Calumet & Hecla jig-tailing, the highest in crushing-resistance, is shown to be 3.6 times that of the Ray Consolidated, the lowest in crushing-resistance.

Just how reliable the data obtained in such a series of tests would be in making estimates as to capacities of ball-mills on different ores based on comparative crushing-resistance tests, I would not venture to state, but I believe that preliminary tests of this kind when using representative samples of ore from a mine, the crushing-resistance of which has already been determined by actual mill-operation and comparing this to an ore whose crushing-resistance has not been determined in actual mill-practice, should give a good indication of the capacity of ball-mills upon the latter ore.

There is, of course; the objection to this kind of an experiment that it is 'batch' grinding and does not conform to the regular ball-mill practice of continuous discharge; and there is the further objection that on ores of different crushing-resistance the blow required to crush the ore would have to be increased in proportion to the increase in crushing-resistance and therefore the grinding media used in one case would not be suitable in the other. In an article in Bulletin No. 146 of the Institute, by E. W. Davis, to which I shall have occasion to refer later, it is indicated that the size of the balls used in ball-mills should be such as to make it possible for the smallest ball to break the hardest and largest piece of ore fed into the mill. The experiments carried on by Mr. Davis do not indicate that a $\frac{3}{4}$ -in. ball is large enough to break a hard ore having a maximum size of $\frac{1}{4}$ in. as satisfactorily as larger balls. In other words, while the $\frac{3}{4}$ -in. balls might do the most satisfactory work on softer ores, the same thing would not necessarily apply on ores having the greater crushing-resistance. It is, of course, also impossible to determine the relative amount of work done on the different ores beyond minus 200-mesh by the ordinary screen-analysis. This further complicates the problem of finding the exact relative crushing-resistance of different ores. Nevertheless, if it is found that for the most economical metallurgical results, it is necessary to reduce an ore to a point where a definite proportion is to be minus 100 or 200-mesh, and any additional reduction in size beyond that point does not affect the metallurgical recovery, then it would seem that for all practical pur-

poses the only thing that needs to be determined is the machine or machines that will have the capacity to reduce the required tonnage of ore to the necessary fineness in the most economical way. It would therefore appear that while tests like those made by Mr. Lenox may not give an absolutely reliable basis for making estimates as to the exact capacity of a ball-mill of a given size supplied with a feed of a given size, yet I am of the opinion that a reasonably close estimate may be made from such tests based on the comparative grinding-resistance of the different ores. The tests show that there is a wide difference in the work required to reduce an ore like that of the Portland mine as compared to the work required to reduce a much softer ore like that of the Ray Consolidated. That there is great variation in the capacity of a ball-mill on two different types of ore, not only in the capacity of the mill but also in the wear of balls and liners, is proved easily in actual practice by making a survey of the data obtainable in operating plants where these machines are in use. It is, therefore, not surprising to find that a ball-mill rated at 200 or 250-ton capacity based on the duty of mills when working on soft ore has this nominal capacity cut in two when the mill is put to work on a harder and different type of ore.

At this point I would like again to refer to the article by Mr. Davis on 'Fine-Grinding in Ball-Mills' in greater detail. In this paper the many phases of fine-grinding in ball-mills are discussed exhaustively, not only from the standpoint of the particular test-runs in the series of experiments but also from the strictly theoretical viewpoint of ball-mill grinding. Without making any comments on the purely theoretical part of the article, I would like to summarize briefly the scope of the Davis experiments and the conclusions reached.

The ore used in the tests was a hard and tough iron ore from the Mesabi range; the hardness was 7 and the specific gravity of the ore was 3.4. This high specific gravity was due to a high magnetite content. The purpose of the tests was to find the most economical way of reducing the ore from $\frac{1}{4}$ -inch to 200-mesh. The equipment used was an 8-ft. by 22-in. Hardinge conical mill and a duplex Dorr classifier of the bowl type. The mill carried a load of 28,000 lb. of balls. Tests were made on light and heavy feeds, open and close circuit, single and two-stage crushing, large and small balls, and various speeds of the mill.

The deductions made from the tests can be summarized as follows: An increase in the tonnage fed to the mill resulted in an increased crushing efficiency; close-circuit crushing is more desirable than open-circuit; two-stage crushing is more efficient than single-stage. The proper adjustment between the size of the balls and the speed of the mill can be secured by a screen-analysis of the discharge from the mill or from the sand from the classifier. If this sand is crowded with the finer sizes, then either the balls are too large or the speed of the mill is too high. On the other hand, if the classifier sand is crowded with the coarser sizes, the indications are that the balls are too small or the speed of the mill is too slow. The smallest

ball of uniform size that can crush the ore should be used, but balls smaller than can crush the largest particle of ore should not be kept in the mill, as they take up space, absorb power, and are inefficient for crushing. These deductions are interesting, even though it is impossible to subscribe to all without reservations. It is obviously an advantage to have the ball-load consist of balls no larger than are required to do the work, because more of the smaller size of balls can be charged to the mill, and if the feed to the mill is a sized product having $\frac{1}{4}$ -inch as the maximum size, as was the case in the Davis tests, it is apparent that balls approaching more nearly to uniform size can be used than if a mixed feed or crusher-product was delivered to the ball-mill.

The experience of ball-mill practice has been that when a coarse mixed feed is delivered to the mill, it is necessary to maintain a ball-load of mixed sizes; and in tube-mill practice it has always been my experience that pebbles of mixed sizes gave better grinding-efficiency than pebbles of uniform size.

Anyone that has attempted to start a tube-mill with pebbles of the same size, especially if the feed to the mill is such as to require pebbles of large size to crush the ore, has found that a mill operating under these conditions gave unsatisfactory results and that the efficiency of the mill gradually increased as the pebbles wore down to a variety of sizes. Furthermore, to the best of my knowledge there is nothing in ball-mill experience that would indicate that the size of the smallest ball in the ball-charge to the mill should be such as to make it possible for it to break the hardest particle of ore in the mill-feed, and such objections to the use of small balls as that of preventing the freer migration of the ore through the mill does not carry much weight, for when a mill is in action there is ample chance for the movement of ore through the mill under proper pulp-dilution, without going into such refinements as the interstitial spaces between the balls. It must also be borne in mind that the pressure exerted on a particle of ore, or the blow struck by a ball, is not only dependent upon the mass of the ball and the distance of the drop, but also upon the position of the particular ball in relation to the other balls in the mill.

While it is impossible to be in full accord with the deductions drawn by Mr. Davis, his many test-runs render his article exceedingly suggestive. It would be interesting to know what machines will be adopted to reduce the ore in question from a crusher-product to the final 200-mesh fineness. I opine that three-stage crushing at least will be employed, no matter what machines are used in the operation.

Knowing the character of the ore, the fineness to which it must be reduced to obtain economic metallurgical results, and the tonnage to be handled, the fine crushing problem should resolve itself into one of the following methods, if ball-mills are to have a place in the fine-crushing operation.

1. Reduce crusher-product in a single-stage ball-mill operation.

2. Reduce crusher-product in a two-stage ball-mill operation.

3. Reduce crusher-product in cracking-rolls followed by single-stage ball-mill operation.

4. Reduce crusher-product in cracking-rolls followed by two-stage ball-mill operation.

5. Reduce crusher-product in coarse and fine rolls followed by single-stage ball-mill operation.

6. Reduce crusher-product in coarse and fine rolls followed by two-stage ball-mill operation.

I am, of course, not prepared to prove that one of these combinations is the best and only way to reduce ore, for I am fully aware that in many instances the Symmons disc-crusher in one or more stage-crushing can practically do the same work as the rolls, nor am I unaware that the stamp in some instances seems to defy replacement. And furthermore at the present time there is much work being done to place an improved mechanical rod-mill on the market. The grinding principle of rod-mills—a series of small rolls—is good, and it is possible that a machine of this type, when mechanically right, will make inroads upon the work of the ball-mill. It may be suggested further that if the ore is reduced to 4 or 8-mesh in rolls, why not complete the grinding operation in tube or pebble-mills in accordance with the old practice. These are all questions that are rightly open to discussion.

It is, nevertheless, a fact that nearly all late installations of fine-crushing equipment for reducing ore for all-sliming, and especially for concentrating purposes, embrace one of the six combinations mentioned above. While this is not proof absolute, it is at least good evidence that one of these combinations in fine crushing conforms to the best practice of the day.

In commenting on the first of the six combinations, it would appear that to reduce an ore from a crusher-product having a maximum size of 2-in. or $2\frac{1}{2}$ -in. ring to a 50-mesh product in a single-stage ball-mill operation is only justified in plants of limited capacity or in case of an ore having a low crushing-resistance, and even in this latter case it would seem of doubtful economy and become a question of local determination. The two-stage fine-crushing combination, on the whole, would seem advisable where the capacity of the plant requires two grinding-machines, and the present practice would indicate that a two-stage reduction from a crusher-product to an all-slime product is not only more elastic but also more economical than single-stage reduction.

In some recent fine-crushing equipments it has been found necessary, or at least advisable, to precede the two-stage ball-mill operation with cracking-rolls in order to give the primary ball-mill a finer feed than the crusher-product. It is, of course, possible that using larger balls in the primary mill might overcome the difficulty of crushing exceptionally hard tough ore. At the Alaska Juneau, I am told, 5-in. balls that failed to do satisfactory work were replaced with 7-in. balls to great advantage, increasing the crushing-efficiency of the mill.

In the combination having coarse and fine roll-reduc-

tion preceding the final grinding in ball-mills, the practice at the Alaska Gold mill is a good example. The ore is there reduced to about 8-mesh in coarse and fine rolls, and it is doubtful if this type of ore is now being reduced anywhere from a crusher-product to 8-mesh in other machines equally economical. It would certainly appear that it cannot be done in ball-mills. It is, of course, difficult to make true comparisons of cost between different plants, as identical conditions as to character of ore and final diminution of ore rarely obtain. There are also certain objections to dry-crushing in rolls, especially where the ore is soft and dry on account of 'dusting'. In this connection, it is worth recalling that such plants as the Anaconda and Utah Copper, where dry-crushing in rolls plays such an important part, little or no inconvenience is experienced in this regard.

Two-stage roll operation followed by two-stage ball-mill operation may be justified in exceptionally large-scale operations where the crushing resistance of the ore is high and great fineness is required in the final product. Rolls, while they require more attention than ball-mills, are more or less fool-proof machines and they are exceptionally elastic as to capacity. The wear on roll-shells, when compared with the wear on balls and liners in ball-mills, is so much less as to offer no comparison; this, in part, may be explained by the fact that there is less wear in crushing ore dry than in crushing it wet. Moreover, when a roll receives a heavy feed a great deal of the crushing is 'ore against ore', as only a small part of the ore actually comes in contact with the roll-shell. In ball-mills, the crushing is either by impact or attrition; in either case there is certain to be considerable wear of 'iron against iron'.

There may be those who are so firmly wedded to the ball-mill that they object to complicate the crushing scheme by the introduction of rolls, and it is possible that a primary ball-mill of exceptionally heavy construction, designed especially for coarse crushing with large balls, would do in a single operation practically the same work as would be done by coarse and fine rolls. This method, even if it required a three-stage ball-mill operation, would simplify the final crushing, but I believe at a considerable increase in operating costs as compared with dry-crushing in rolls.

A single operation, such as the "one easy step", would greatly simplify the grinding problem, but a machine like the human animal has its limitations and it is apparent that, as yet, there is no way to escape from stage-crushing. In large operations, we may look for refinements in more stage-crushing. Certainly any progress in rod-mill reduction would depend on sized feeds, and a series of stage-reductions.

Such phases of ball-mill crushing as the relation of the wear of the balls to the speed of the mill, the size of the mill and the volume of the ball-load, offer interesting problems for definite and conclusive solution. Mr. Davis, in his paper, makes the statement that the ball-load should not occupy more than 60% of the mill-volume on account of interference between the balls, and not less

than 10% of the mill-volume on account of slippage. This range seems much too great, for it is evident that carrying a load of only 10% of the mill-volume does not work the mill to its capacity. There are also other reasons why the volume of the mill occupied by the ball-load should bear some definite relation to the total volume of the mill. Some time ago my attention was called to the work of a tube-mill in which pebbles were replaced by balls. The ball-load was made up of the same weight as the original pebble-load; the wear of the balls under these conditions was almost prohibitive. When the inside diameter of the tube-mill was reduced from 5 ft. to 3 ft. by wooden lagging, there was not only a saving in power but the consumption of balls was also greatly reduced without reducing the grinding efficiency of the mill.

Similar reductions in the diameter of the Hardinge mills at Anaconda when using steel balls instead of pebbles was made for a good and sufficient reason. Likewise a reduction in the speed of mills has sometimes resulted in the economy of power and wear, without decreasing the efficiency of the mill.

The crushing in ball-mills is by impact and attrition. The amount of work done by impact is naturally dependent upon the cascading action of the balls. This latter action is in turn dependent upon the speed of the mill. When treating fine mill-feeds, the crushing can be done by attrition, and there should be less occasion for impact crushing and it would be interesting for some one in a position to do so to determine the relative ball-wear and crushing-efficiency when operating mills at such speeds as will give rolling and cascading action to the balls.

THE U. S. Bureau of Mines gives some interesting details of the mine operations at the Ottawa shaft of the Oglebay-Norton Co., Montreal, Wisconsin. Typical sub-level open stoping is used, as the capping rock is hard and stands well, with small orebodies at the top of not over 50 ft. average width. Raises for chutes are driven frequently enough so that no shoveling is required. This is one of the few companies on the Gogebic range using underground magazines for explosives. The usual precautions are taken by having separate magazines for caps and dynamite. All caps are crimped on standard fuse lengths by a powder man on each shift and requisitions, issued by the shift boss, are required for dynamite and caps. A compressed-air receiver is situated on each working level in the mine, instead of having a large receiver near the compressor. This practice is followed, according to the superintendent, to furnish dry air to the machines, and at a higher pressure than could be obtained by the usual practice of having the receiver on the surface. A machine-drill man inspects all machines each day. Drills needing repairs are taken to a repair shop on the main level and repaired at once. This mine has an underground drill-sharpening and blacksmith shop. Oil is used for fuel and the gases are exhausted into the upcast main hoisting shaft. The shop is situated at a station near the main hoisting shaft.

The Reaction of the Manganese Industry

By H. A. C. JENISEN

*During the first nine months of the year 1919, 34 shippers of high-grade manganese ore reported shipments of 53,772 tons of ore containing 35% or more of manganese. During the corresponding period in 1918, 192 similar shippers reported shipments of 228,901 tons of ore containing 35% or more of manganese, or 4.25 times as much. From July 1 to September 30, 1919, inclusive, only 9233 tons of high-grade ore was shipped, and virtually all of this came from Arkansas and Montana. California and Colorado, which had previously been two of the largest producers, shipped practically no ore of this grade. The decrease in the shipment of high-grade ore during the first half of the year was continued into the third quarter, in most districts reaching the point of no shipments whatever.

The shipments of ores containing 10 to 35% of manganese for the first nine months of 1919 amounted to 164,539 tons, whereas the shipments for the corresponding period of 1918 amounted to 595,708 tons, or 3.62 times as much. During the third quarter of 1919 the shipments of ore of this grade amounted to 78,381 tons, which was almost as much as was shipped during the first six months of the year. This substantial increase came almost entirely from Michigan, Minnesota, and Nevada. The increase in the output of Michigan and Minnesota was due largely to the opening of the lakes to navigation during the summer rather than to an increase in demand, although the high iron content of both the intermediate and the low-grade ores shipped from Michigan and Minnesota, particularly from the Cuyuna range, has probably contributed largely to the demand for ore from those districts.

The operators in Nevada have been able to maintain a high rate of production because practically all the ores mined there are sold to smelters for use in fluxing, so that the conditions which apply to ore used in the manufacture of manganese alloys do not affect the Nevada industry.

The shipments of 5 to 10% ore during the first nine months of 1919 amounted to 83,560 tons, all of which came from Minnesota. During the third quarter of the year Minnesota shipped 66,688 tons of this ore, which was more than 4.26 times the shipments from this State for the previous six months. This great increase in shipments was due largely to the opening of the lakes to navigation and to the subsequent shipment of ore previously mined. During the first nine months of 1918 the shipments of ore of this grade were 188,186 tons, or 2.25 times the shipments during the first nine months of 1919. The production of low-grade ores during the first

nine months of 1919 more nearly equaled the production of like ores during corresponding periods in 1918, but the same cannot be said of the production of the higher-grade ores. The following table shows the shipments by States for the first nine months of 1919:

Manganese and Manganiferous Ore Shipped During the First Nine Months of 1919, by States

	35% or over		10 to 35%		5 to 10%	
	Number of shippers	Gross tons shipped	Number of shippers	Gross tons shipped	Number of shippers	Gross tons shipped
Alabama	1	40	..	..	..	..
Arizona	3	273	1	1,000	..	..
Arkansas	5	2,290	1	78	..	..
California	7	10,942	..	..	..	..
Colorado	2	13,147	*1	*9,861	..	..
Georgia	1	48	1	3,064	2	210
Michigan	..	..	1	23,221	..	..
Minnesota	..	..	3	42,422	2	82,334
Montana	6	23,070	..	..	..	..
Nevada	1	78	3	65,800	1	1,016
New Mexico	..	..	3	12,398	..	..
North Carolina	..	..	1	30	..	..
Tennessee	3	121	..	..	..	..
Virginia	5	3,763	1	5,765	..	..
Wisconsin	..	..	..	..	11	111,013
Total	34	53,772	*16	*164,539	15	183,560

*Fluxing ore from Colorado not reported quarterly and not included in totals.

†Ore from Wisconsin containing approximately 5% manganese not included in totals for the United States.

The imports of manganese have in general suffered a decrease as great as that of the domestic shipments. The imports for the three months ending September 30, 1919, have been only 43,426 tons, whereas those for the previous six months were 225,985 tons, making a total for the first nine months of the year of 269,411 tons. Had the rate reached during the first six months been maintained the imports for the first nine months of the year would have nearly equaled those of the corresponding period of 1918.

During the third quarter of the year only 30,136 tons of ore and oxide were imported from Brazil, which is about 17.4% as much as was imported from that country during the first six months. Costa Rica, England, Mexico, and Asiatic Russia contributed most of the remaining 13,290 tons imported during the third quarter. The imports from Asiatic Russia during the third quarter were 4089 tons. These were the first imports from that country during 1919. The following table shows the imports of manganese ore by countries for the first nine months of 1919:

Manganese Ore and Oxide Imported Into the United States During the First Nine Months of 1919

Country	Long tons	Country	Long tons
Portugal	400	Colombia	10
Russia (in Europe)	1,327	Ecuador	20
England	4,432	British India	1,500
Canada	207	China	1
Costa Rica	9,988	Hongkong	1,260
Panama	2	Japan	508
Mexico	5,309	Russia (In Asia)	4,089
Cuba	33,788	Australia	548
Argentina	2,305	British South Africa	141
Brazil	203,132		
Chile	441	Total	269,411

*A preliminary report, U. S. Geological Survey.

The decrease in imports might be encouraging if it was the result of an increased use of domestic manganese ore in the steel industry, but no such increase has been reported. As it is the custom of the makers of ferro-manganese and steel and the brokers to maintain stocks sufficient to supply the demand for six or eight months, the decrease in the domestic production and imports indicates that a great supply is on hand which cannot be utilized until the steel industry becomes normal. The decrease in imports must therefore be considered temporary, and a reaction may be expected soon after the steel industry becomes stabilized. The principal reasons for a probable increase in the imports of manganese are the high grade of the foreign ores, the cheapness with which they can be mined, and the low cost of transportation.

Since the Armistice was signed the decrease in the production of domestic manganese ore has been continuous and rapid. Nearly all the domestic ore shipped in 1919 has been shipped under war contracts that did not expire until the summer of the year. With the expiration of these contracts very few producers have been able to market their ore, and the industry has therefore suffered a serious reaction, which has caused considerable losses to many operators.

The causes that have combined to produce the present conditions are many and various, and notable among them are the sudden removal of the war demand, the release of shipping for importation of foreign ore, labor troubles among both producers and consumers, the inability of the domestic ore to compete in cost and grade with foreign ore, the large stocks on hand, and the conservative interpretation maintained as to the scope of the War Minerals Relief Act.

The cessation of the war demand for steel was necessarily followed by a decrease in the demand for manganese, and consequently there was soon accumulated considerable stocks of manganese. These cannot be utilized until the steel industry becomes adjusted to peace conditions and the peace demand and production of steel increases and becomes stable.

Labor conditions, particularly in the coal and steel industries, have decreased the production of steel and have therefore diminished further the demand for manganese. This demand is based primarily on the actual production of steel; consequently before an increase in the demand for manganese is possible the actual production of steel must be materially increased; an increase only in the demand for steel can have no effect on the manganese industry until the steel producers are able to respond to that demand. There is now undoubtedly an increasing demand for steel, but an increased production of steel is at present probably impossible on account of the conditions of labor in the steel and coal industries.

The tremendous impetus given to the domestic manganese industry during the War was due not so much to economic conditions as to strategic considerations. Early in the American participation in the War it became evident that the country would soon be facing the danger of

a very serious shortage of manganese, due, of course, to the success of the German submarines in sinking cargo ships, to the increasing demand for transportation of men and supplies overseas, and to the tremendous increase in the demand for war materials made by the American government upon the steel producers. To avert this danger a carefully planned campaign for the encouragement of domestic production of manganese was begun. This campaign consisted of a careful examination, largely by the United States Geological Survey, of all the known possible domestic deposits, together with a direct and general appeal by several Government agencies to the producers for more manganese. The response with which this appeal was met is best indicated by the fact that in the third quarter of 1918 the United States supplied almost a third of its requirements.

Much of the production was made at an actual loss, in spite of the high prices current during the period. Some of the loss was due to the fact that the actual cost of mining the ore was greater than its price. At some properties, however, the ore was produced at a profit, but the demand was of such short duration that a sufficient amount of the ore could not be sold to cover the initial cost of purchasing and developing the properties.

The cost of mining manganese in the United States being so much higher than the cost in foreign countries and the grade of the domestic ore in general being lower than that of the foreign ore, the domestic producers cannot readily compete with the foreign producers under the present tariff as long as sufficient shipping is available.

An effort is being made to put a protective tariff on many minerals, metals, and alloys, manganese among them. If this effort is successful the manganese industry will undoubtedly enjoy considerable immediate prosperity, but in a very few years of normal steel production, four or five at the most, the known manganese resources of the country will be exhausted. Tariff hearings on manganese have been held in Congress, but no definite action has been taken so far. In the event of another war after the domestic manganese deposits had thus been practically exhausted, or at least very seriously depleted, the country would be facing a much greater danger than it did in the critical days of 1917 and 1918.

DURING October \$12,269,679 in silver was exported from the United States, over 90% of which was shipped to China, and \$8,722,430 in silver was imported, the bulk of which came from Mexico. The following tables show a comparison of imports and exports during October 1919:

Silver Exports to		Silver Imports from	
China	\$10,266,671	Mexico	\$8,060,765
Hongkong	1,013,582	Peru	990,216
Canada	309,979	Central American States	803,635
England	291,422	Canada	315,284
Mexico	133,758	Dutch East Indies	164,959
West Indies	45,000	Chile	105,691
All others	213,267	Colombia	48,635
		All others	33,245
\$12,269,679		\$8,722,430	

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

HOLIDAY SHUT-DOWN AT BISBEE.—SWISSHELM PROPERTY SHIPS.

JEROME.—The Shea Copper Co. will start shipping ore early in January, arrangements having been completed with the United Verde Extension smelter to handle from 300 to 400 tons of ore per month. The ore is high grade, with copper running from 10 to 25%, and should net from \$150 to \$200 per ton. Approximately half a million dollars worth of ore is said to be blocked out underground between the 200 and 300-ft. levels. Control of the prop-

smelter was begun several months ago, but as the railroad was under lease to the Arizona United mines, a fleet of three four-wheel-drive trucks was purchased and shipment started from Cochise. Lately bad roads caused by heavy rainfall have retarded shipment to a great extent. With the opening of rail communication the volume of shipment is expected to be increased. There is enough ore in sight to warrant shipment at the rate of one car per day for several months. The power-plant will be put in operation when a car of fuel oil is received. Ed C. Rice, superintendent, will start driving on the 400-ft. level of



MINE AND MILL OF THE MIAMI COPPER CO., MIAMI, ARIZONA

erty has passed from D. J. Shea and the new management intends to sink the shaft 200 ft. deeper and do considerable lateral development.

BENSON.—The Mining & Development Corporation, with headquarters at Benson, has been made a party to the lease of the Dragoon Northern railroad extending from Dragoon, 23 miles east of Benson on the main line of the Southern Pacific, northward to Johnson where the company's Copper Chief mine is situated. The first two carloads of ore from the mine under the new arrangement were sent to Douglas for smelting during the latter part of December. For several months the company has been developing the Copper Chief on which it holds a ten years lease, but as three large orebodies were encountered shortly after development started, most of the work has been done in ore. Shipment to the Douglas

the company's vertical shaft to find orebodies of which there is evidence on the upper levels.

BISBEE.—The mining properties of this district gave a four-day holiday, December 25, 26, 27, and 28, during which nothing but pumping and necessary repair work was done. The managers of the operating companies announced that this opportunity was given the men to enjoy Christmas. At the same time it gave the Copper Queen and Calumet & Arizona smelters at Douglas an opportunity to catch up on their ore stocks, as all bins at the Copper Queen were full and there was no storage for an additional ton of ore, while the C. & A. was in almost as bad a position.

SWISSHELM GOLD-SILVER.—Robert Randall, superintendent for the Swisshelm Gold-Silver company took the first car of 50 tons of silver ore from Webb to the C. & A.

smelter at Douglas, December 20. The property expects to ship steadily. It is situated 30 miles north-east of Douglas in the Swisshelm mountains, 12 miles east of Webb which is the nearest rail point. The ore is highly silicious, containing gold and silver, and the contract with the C. & S. smelter is understood to be advantageous to the company. The company is under the management of Ben Heney. Ore is freighted by wagon from the mine to Webb, a fairly good road being in existence. The adjoining property, the Great American, owned by Colorado capital, is starting development work preparatory to a period of activity, after being idle since 1884 when the last shipment to the Pueblo, Colorado, smelter showed returns of \$14 in gold and 119 ounces of silver. The recent activity in the silver market has encouraged the company to start active operation once more. The Great American ground, composed of four claims, was patented during the early mining history of Cochise county. The value of the ore deposition was not appreciated until 1905, when the original owners of the group now belonging to the Swisshelm Gold-Silver company, first acquired the property.

GLEESON.—A small force has gone to work on the Tejon mine belonging to W. H. McKittrick, who is expected to make a visit here shortly after the first of the year. His visit is taken to mean that operations will be opened on a larger scale. J. W. Bennie, manager of the Copper Belle properties of the Shannon company, has moved his headquarters here from Douglas and definite announcement of the company's intentions for future operation is expected to be made soon. Thomas Cowan, who owns several promising silver, gold, and copper properties, is shipping to the smelter at Douglas some good ore which he recently opened up.

COLORADO

CARBONERO PROPERTY SOLD.

TELLURIDE.—The heavy snowfall of the past month has curtailed ore shipments considerably. The railroad was blocked for a period of one week, from December 8 to 15. The Tomboy is now shipping concentrate from the new mill. The Smuggler Union Mining Co. is operating the new ball-mills at full capacity. A new brick assay-office is now under construction, replacing the one destroyed by fire.

OPHIR.—An important mining deal was closed when the ownership of the Carbonero passed to an Eastern syndicate, at a reported price of \$250,000. The mine has been a producer for the past 20 years, keeping up a steady production of ore averaging \$50 per ton. There are still large ore-reserves. Johnson, Klang & Troseth have leased the Santa Cruz mine in the Iron Springs district, from Painter, Toll & Brown, the owners of the property, and are making shipments of ore. The Santa Cruz carries an ore of a similar character to that of the Carbonero. The Silver Canon Mining Co., a Michigan corporation, is developing its property, and shipping ore. J. M. Belisle is disposing of some of his numerous properties in the vicinity, the Deadwood mine to a Michigan

company and the Crown Point to Gideon Baril. Mr. Ruuttilla is starting development of the Favorite, having installed a gasoline hoist and will open up virgin ground through contract.

MICHIGAN

NOVEMBER COPPER PRODUCTION.

HOUGHTON.—The actual output of copper mines of Michigan for the month of November is practically the same as the output for October. In the larger mines there was little change. White Pine, a Calumet & Hecla subsidiary which re-opened in October, did not get its stride until November. La Salle and Superior, two smaller Calumet subsidiaries, dropped out altogether in the November figures. Limited work is being done at these properties, entirely exploratory in its nature, and the copper ore that is coming into the market is negligible.

Calumet & Hecla showed a decrease in output. This was not due to any change in general mining conditions but rather to the suspension of operations at one of the flotation plants. This production from the sandpile in the lake is becoming more and more a factor for the future consideration in the grand total of the Calumet & Hecla's record of output. Osceola continues to fall off a little month by month, in ore tonnage, in copper output, and in the quality of the production of the mine, the average being just over 15 lb. per ton. Ahmeek continues to be the best high-grade producer for the Calumet group.

The most remarkable demonstration of continued high-grade output is Mohawk. The showing of 24 lb. per ton in October was better in November when figures show 25.31 lb. This is the highest average that the Kearsarge lode is showing anywhere at this time. It is interesting to observe that the mine is maintaining a cost sheet which is creditable. Champion, Baltic, and Trimountain did not quite maintain their October showing in November. The figures follow:

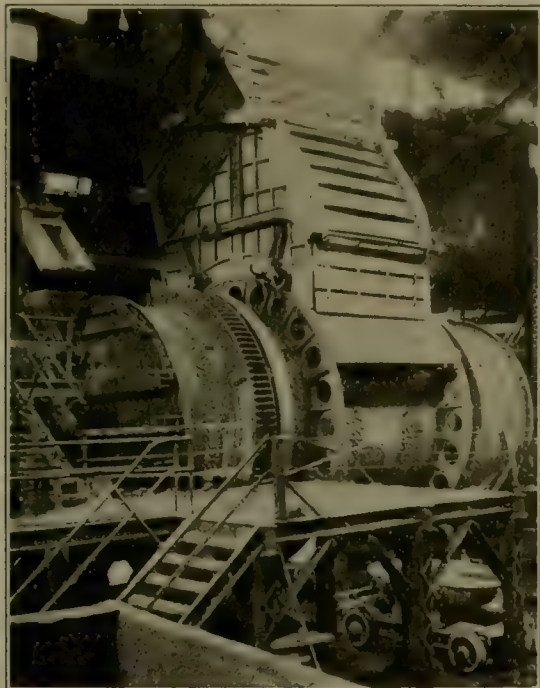
Mine	Ore tonnage	Pounds per ton		Refined Nov.	Refined Oct.
		Nov.	Oct.		
Ahmeek	69,000	23.2	24.56	1,604,600	1,670,142
Allouez	18,000	18.2	19.86	328,100	337,628
Baltic	17,400	36	34	626,400	697,000
Calumet & Hecla	202,277	25	25	5,056,926	5,313,583
Centennial	7,000	14.4	16.9	101,000	114,500
Champion	37,000	40	40	1,480,000	1,640,000
Isle Royale	65,000	19.4	19.18	1,260,573	1,304,036
Mass Con.	14,000	15	15	210,000	198,632
Michigan	5,000	20	23	100,000	112,000
Mohawk	40,828	25.31	24.34	1,033,322	1,062,279
Osceola Con.	59,000	15.3	16.14	904,714	936,352
Quincy	94,000	18	18	1,692,000	1,728,000
Trimountain	13,000	25	25	325,000	350,000
Victoria	6,750	16	14.4	108,000	110,160
Wolverine	22,567	14.53	16.62	327,970	399,249
Winona	9,000	15	15	135,000	95,000
White Pine	.....	..	..	242,843	13,600

Winona will start working both 'heads' this week, due to increased ore production. Winona continues to add to the underground working force by employing men formerly working at the Mass Consolidated. The Quincy's new hoist at No. 2 shaft will be ready to operate by June 1, 1920, according to present plans. White Pine is putting on additional men, and the grade of ore quality is holding up to average.

NEVADA

GOLDFIELD PRODUCTION FOR 1919.—ACTIVITY IN EUREKA.

DIVIDE.—Eighteen inches of ore assaying \$600 and 16 in. assaying \$760 has been opened in a cross-cut driven west from the bottom of the 200-ft. Caldwell shaft of the Divide Extension, according to unofficial reports. The work on the 200-ft. level of the Divide Ex. has been the centre of interest in the district for a long period. A fault continuing from the upper levels was thought to be the hanging wall of the vein when first cut. Only unimportant assays were secured at this point and the work was continued, leading to the opening of the rich ore.



13-FT. PIERCE-SMITH BASIC-LINED CONVERTER IN THE GARFIELD SMELTER

The new shaft of the Belcher Extension, now slightly over 100 ft. deep, is in ore of an average value of from \$100 to \$125. No lateral work has been done to determine the width of the vein. The shaft of the Tonopah Divide, being sunk from the fifth, or 580-ft. level, is 630 ft. deep.

GOLDFIELD.—Preliminary estimates indicate that the production of the Goldfield district for 1919 was close to \$700,000. Latest estimates put a value of \$260,000 on the output of the Florence. Including bullion produced from the mill clean-up, the Consolidated output was \$263,300, most of this sum coming from the clean-up, as only 5165 tons of ore was milled to February 1, when the mines and mill were taken over by the Development company. A segregation of the \$263,300 is not available. The Development produced 4575 dry tons of a gross value of \$134,028, or a per ton value of \$29.30. The Jumbo Extension produced 132 dry tons of a gross value of

\$9914 as a result of work by lessees, and the output of the Great Bend was 85 tons of a gross value of \$2055. This gives a total of over \$669,000 and it is believed the final figures will reach \$700,000 because many of the important items in the Consolidated estimate are net. The Florence leases for 1920 have been let and an announcement from the management giving details is expected in a short time. The Florence Divide is expected to sign an agreement giving that company the most desirable part of the block mined last year. The Cracker Jack is understood to have secured a valuable part of the block.

SIMON DISTRICT.—A full face of silver-lead ore assaying \$12 has been opened in a cross-cut driven 80 ft. to the vein from the bottom of the 280-ft. shaft of the Simon Mina. A snow-covered road to the mine that is in poor condition makes economical operation difficult and it has been decided to suspend work until March.

ARROWHEAD.—Seams of rich silver-gold ore are being cut in a raise from the south-east drift on the 175-ft. level of the Arrowhead, indicating approach to the ore-shoot and proving that it rakes sharply in this direction. Fifteen inches of high-grade ore has been found beyond what was thought to be the foot-wall of the vein on the 100-ft. level. The average width of the ore at this depth is 8 ft. and the shoot has been opened for a length of 60 ft., with the face of the drift still in high-grade material.

EUREKA.—The Silver Lick group of 10 claims in the Adams Hill part of the district has been sold to Hayden, Stone & Co., of New York, for a price reported to be \$100,000, with a cash payment of \$10,000. The claims have been developed to a depth of 150 ft. through two shafts and it is said that they have heretofore produced \$250,000 worth of silver-lead ore. The Bullwhacker Consolidated Mines Co. has been formed to re-open the Bullwhacker and Silver West in the same part of the district. The company is controlled by the Eureka-Holly interests. The two groups, which adjoin the Holly on the strike of the vein, have been developed on a large scale to a depth of 300 ft. and have produced over \$400,000. The main shaft is 400 ft. deep. Work has been stopped in the 300-ft. winze from the 400-ft. level of the Croesus. Drifting has been started from the bottom of a 45-ft. vertical winze in the 'cave' orebody on the 200-ft. level, southwest of the Catlin shaft, and a promising shoot of rich ore is being opened. Ore of high grade is being found in a drift and raise on the 400-ft. level, far north of the shaft, where a search for the downward extension of the Dunderberg orebodies is being made.

UTAH

REVIEW OF UTAH'S PRODUCTION FIGURES FOR 1919.—DIVIDENDS FROM PARK CITY AND ALTA.

SALT LAKE CITY.—With the handicap of adverse economic conditions occasioned by the ending of the World War, mining activity in Utah during the past year has been greatly retarded. Added to the poor copper market conditions, the lead market for a large part of the year was in an unhealthy condition, so that the big lead producers naturally followed the copper producers and

curtailed operations. Coupled with the adverse market conditions, litigation involving some of the largest mines in the State, and a period of labor agitation in the Park City district, were factors in reducing ore production. All of the factors combined resulted in the production of metal in Utah dropping from a total value of \$86,047,597 in 1918 to approximately \$45,737,683 in 1919. The estimated gold production in 1919 is \$1,899,924, as compared with \$2,949,170 in 1918. The estimated value of 11,719,463 oz. of silver, assuming an average price of \$1.09 per ounce, would be approximately \$12,789,450, as compared with a production of 13,455,597 oz. during 1918, at an average value of \$1 per ounce. The estimated production of copper during 1919 is 127,092,221 lb., as compared with 227,169,630 lb. in 1918, which shows a curtailment of nearly 50%. The value of the 1919 production of copper is estimated at \$24,147,522, as compared with \$56,110,899 for the previous year. The lead production for 1919 is estimated at 124,213,073 lb., as compared with 167,008,224 lb. in 1918. Conditions at the close of 1919 are encouraging to the silver and lead producers of the State, but the condition of the copper metal market is such that there is no immediate prospect of the State's copper mines going back to a 100% basis of production. All of the smelters in the State operated throughout the year at reduced capacity. On January 1, 1919, the Utah Copper Co. discontinued operations entirely at its Boston mine at Bingham, and closed down its leaching plant and the greater portion of the Magna plant at Garfield. On March 1, the Magna plant was closed down completely, only a small force of men being kept for construction and remodeling work; all tonnage mined was treated at the Arthur plant during the rest of the year. All of the mills erected to re-treat tailing at Park City are now out of existence and the plants dismantled. The Midvale Minerals Co.'s plant at Midvale, built for the purpose of re-treating tailing from the United States concentrator, also suspended operations after encountering financial difficulties. The Judge electrolytic zinc plant at Park City was closed early in the year and did not resume operations.

EUREKA.—Operations at the Chief Consolidated mine were suspended from December 24 to 27, inclusive, during which time additional pumping equipment was installed. Three new centrifugal pumps have been received. A new 8-in. water column was put down the shaft. When centrifugal pumps were first installed the past summer, provision was made so the shaft for the discharge pipes was sufficiently large to carry water for four such columns as are now in use. The flow now is approximately 800 gallons per minute, being increased during the last few weeks by the water drained from the new shaft by the Plutus drift. Work in the No. 2 shaft of the Chief mine is progressing rapidly, with no water to contend with, and there remains but 60 ft. before connection will be made with the raise from the drift on the lowest level of the mine.

Operations at the Tintic Milling Co.'s plant are at a maximum. For the past few months the mill has been handling much of the low-grade product of the Chief

Consolidated, the Dragon Consolidated, and the various Jesse Knight properties. The plant is now treating about 300 tons per day with a chloridizing-leaching process known as the 'Holt-Dern Process', originally developed at Park City.

Ore shipments from this district for the week ending December 20, totalled 129 cars, a decrease of 14 cars from the previous week's shipments. A shortage of coal at several of the properties has caused some reduction. The Chief Consolidated shipped 36 cars; the Tintic Standard, 24; Dragon, 14; Iron Blossom, 12; Eagle & Blue Bell, 10; Mammoth, 6; Grand Central, 5; Centennial-Eureka, 5; Colorado, 5; Swansea, 4; Gemini, 2; Alaska, 2; Sunbeam, 2; Victoria, 1; Ridge & Valley, 1.

Directors of the Tintic Standard Mining Co. held a special meeting on December 22 and declared an extra dividend of 15c. per share, payable December 24. This, with the regular dividend of 8c., will make a total dividend of 23c. per share for the last quarter of the year. There are 1,175,000 shares of stock outstanding, so that the dividends for the quarter will total \$270,250, bringing total dividends for the year up to \$552,218, and the total to date \$1,234,674.

PARK CITY.—Discovery of a bedded deposit of high-grade carbonate ore, four feet thick, is reported from the Silver King Consolidated mine. It is some distance south of the bedding opened in September, and is surrounded by unexplored territory. It is said that the ore is of the same character as the carbonate produced by the bedding in the north end of the 'Electric Light' claim, which averages \$50 to \$60 per ton, net. The usual rate of progress is being maintained by the company in driving the Spiro tunnel, which is in more than two miles and will soon be under a prospect shaft on the 'Marconi' claim, where there are indications of ore. Beyond this point the tunnel will pass in rapid succession through the series of fissures famous for their productivity in the Silver King Coalition and the easterly workings of the Silver King Consolidated.

Shipments of ore from the camp for the week ending December 20 totalled 1978 tons, of which the Judge M. & S. Co. shipped 671 tons; the Ontario Silver, 548 tons; the Silver King Coalition, 505 tons; Iowa Copper, 55 tons; Naildriver, 55 tons; and Daly-West, 143 tons; total, 1978 tons.

ALTA.—At a meeting of the directors of the Cardiff Mining & Milling Co. on December 19, a dividend of 15c. per share was declared, payable December 24. This will call for the payment of \$75,000, and will bring the total dividends paid by the company up to \$800,000. The present dividend is the first paid the stockholders since October 1, 1918.

Through a deed just filed with the county recorder, two claims owned by the Tipperary Mining Co. become the property of the Emma Silver Mining Co. These two claims, the 'Revolution' and 'Mackay', cut into the property of the Emma Silver, and rather than have any difficulties in the future, the Emma company purchased the ground, and in so doing squared off their extensive holdings in the camp.

BRITISH COLUMBIA

AGREEMENT REPORTED BETWEEN OPERATORS AND UNIONS.

VICTORIA.—An agreement is reported to have been reached between the operators and the miners of District 18, United Mine Workers of America, which comprises eastern British Columbia and the Province of Alberta. The agreement reached covers an increase of 14% in the men's pay and also stipulates that only members of the U. M. W. of A. may work in the mines of District 18. G. Robertson, Minister of Labor, in discussing the situation said: "I have no statement to make regarding the 'One Big Union' other than that contained in my letter to Henry Beard in reply to a communication that he addressed to me. I feel that from the information contained in my reply the public will approve and endorse the course taken by the coal operators and the United

tinient, assaying between 15 and 19%. The Texas Creek mine was opened in 1914 and taken over by the present company in September 1918. Since then the company has made cuts to 900 ft. and has taken out 16 tons of ore, half of which was shipped to Ontario while the remainder still is on the dump. All shares in this company are said to have been taken off the market.

That the Lorne and another of the operating properties of Cadwallader creek has been bonded by the Mining Corporation of Canada is reported on good authority. This corporation recently acquired the Pioneer mine on the same waterway.

STEWART.—The Alguaquin Syndicate, of Belgium, has bonded the Northern Light group of eight claims from Charles and William Bunting, original locators of the Premier mine, the Woodbine group, the fraction owned



ON HOWE SOUND, BRITISH COLUMBIA

Mine Workers, and approved by the Director of Coal Operations for the purpose of preventing as far as possible a deliberate attempt, without cause, on the part of the O. B. U. to bring about a tie-up in the coal industry unless they were recognized. That, of course, is out of the question."

The main points in the Minister's letter to Henry Beard are that it is obviously impossible to recognize two organizations as having jurisdiction to negotiate wage agreements for the same workmen; that the United Mine Workers have a well established reputation for respecting and fulfilling agreements made; that the organization Mr. Beard represents has by its acts and utterances of its leaders indicated no tendency to respect or fulfill any contractual obligation, and that the O. B. U. as an organization was wholly unreliable and untrustworthy.

LILLOOET.—Attention has recently been directed to the property of the Index Milling & Mining Co., situated on Texas creek, 12 miles from Lillooet. This company claims to have the highest-grade molybdenite on the con-

tinued by David O'Leary and Charles Lake, and the Cobalt group of three claims, owned by John Hovland. A considerable part of this property adjoins the Premier. There are nine veins on the Northern Light group that have characteristics similar to those on the Premier, while on the Woodbine a body of milling ore has been uncovered 100 ft. in length and 70 ft. in width. W. A. Melloche, who is acting for the Belgian syndicate, has let a diamond-drill contract to Lynch Brothers, of Seattle, who will put three drills to work as soon as the season opens, next spring. W. B. Tanner has acquired the property adjoining the Forty-Nine group, and is forming a syndicate to develop it. A vein of milling ore 27 ft. wide is reported from the New Alaska, on the United States side of the boundary. A Vancouver company is being formed to take over the property adjoining the New Alaska from J. Schwenter, Angus McKenbie, and E. Borson. The new government road from Stewart to Hyder has been completed. Though it is only a little more than two miles long, it has been a costly and difficult piece of construc-

tion, more than half of it being trestle and rock work around a steep bluff. Besides connecting the two towns, the road connects the groups of mines in the Salmon River and Bear River valleys, making the mines readily accessible to both of the towns.

GREENWOOD.—The Bell mine, at Beaverdell, which has been shipping monthly two cars of copper ore assaying 100 oz. silver per ton, recently shipped a car of ore that assayed 502 oz. per ton in silver. After all charges had been paid the car returned the shippers \$17,000.

TRAIL.—The Consolidated M. & S. Co. has cleared the refuse from the fire at the copper-ore crusher, and will erect a much larger plant in its place. The new building will be of reinforced concrete and will cost in the vicinity of \$50,000. The company is doubling the capacity of its machine-shop by the addition of a new wing, having a floor-space of 42 by 100 ft. T. Hopkins, who has returned from England, where he had charge of munition work, has been made superintendent of the electrical work at the smelter. The extremely cold weather has caused a shortage of water, and the Consolidated company has had to close its concentrator.

ANYOX.—The Granby company blew in an additional furnace last month, and is now smelting 80,000 tons of ore per month, an increase of more than 25%.

CARIBOO.—Robert Bryce and associates, who hold an option on the Independent and the Imperial groups, on Proserpine mountain, have secured an option on the Dufferin group from David Moore. Mr. Bryce has driven between 200 and 300 ft. of tunnels on the former properties, as well as a considerable amount of open-cutting, and is anxiously awaiting the arrival of two diamond-drills that are on their way to the property.

ONTARIO

MOLYBDENUM IN QUEBEC.—GOOD OUTLOOK IN COBALT.

TORONTO.—The report of the invention by John O. Arnold, Professor at Sheffield University, England, of a new steel of superior hardness, molybdenum being one of its constituents, has created much interest in Ontario mining circles. During the War molybdenum was much in demand and several important deposits of molybdenite, principally in the Ottawa valley, were developed. Owing to the employment of tungsten as a hardening metal the demand for molybdenum fell off, and since the War there has been no production. Simultaneously with the announcement of Prof. Arnold's invention comes the report of the finding of large deposits of molybdenite in Pontiac county, Quebec. Should the new process prove successful a revival of the molybdenite mining industry on a large scale is anticipated.

The Lignite Utilization Board, appointed by the Canadian government to install and operate a plant in western Canada for the briquetting of lignite coal, of which there are large deposits in Saskatchewan, reports that the plant will be in operation by next August with a capacity of 30,000 tons of briquettes per annum. The Board, which has made an exhaustive examination of the process, visiting many plants in the United States, states that

briquettes can be produced equal to anthracite in heat-value and keeping qualities, and sold for about \$9.40 per ton in Winnipeg. The plant will be situated near Estevan, Saskatchewan. Though the output as compared with the requirements of Manitoba and Saskatchewan will be but a 'drop in the bucket', it is hoped that the project will considerably relieve the fuel situation by proving the commercial feasibility of the process and inducing private capitalists to engage in the industry.

LARDER LAKE.—Contracts by the Associated Goldfields for 5000 ft. of diamond-drilling are approaching consummation. The work has been successful in indicating some rich ore and large bodies of low-grade material. Underground work is proceeding on six faces all in ore. A high-grade shoot 25 ft. wide developed on the 500-ft. level of Block B has been encountered on the 400-ft. level. The company is increasing its working forces. The Larder Swastika Prospectors Association has been organized in the interests of this district and the adjoining area of Swastika. It has actively taken up the transportation question and is urging the Provincial government to construct a railroad to the camp.

COBALT.—The development of a large amount of high-grade ore during the past several months at the Nipissing, as well as recent discoveries of rich ore-shoots on such properties as the Crown Reserve, Beaver Consolidated, and Temiskaming gives promise of a moderate increase in the output from Cobalt during the next few months. The Nipissing continues to produce at the rate of close to \$12,000 daily. As a consequence of having accumulated a surplus of some \$4,300,000 the company will disburse a bonus of 5% in addition to the regular January dividend of 5%, the total disbursement amounting to \$600,000.

According to authoritative advice the Crown Reserve is producing silver in greater volume during the current month than for several months past. Some of the ore recently encountered is equal in richness to the best ever found in the mine. A considerable tonnage containing several thousand ounces per ton has already been prepared for shipment.

The Temiskaming Mining Co. after a lapse of some two years has resumed dividend disbursements and in January will distribute 4%, amounting to \$100,000. The McKinley-Darragh is producing at the rate of 1918, when 904,543 oz. was the output. The oil-flotation plant is still being operated but will probable close some time in February, to be shut down until May. In a semi-annual report just issued by the Peterson Lake Mining Co. it is stated that adequate finances have been secured with which to conduct the contemplated exploration and development work. A recent shipment of ore netted the company \$13,727. In addition to this, the report mentions the sale of 385,000 shares of treasury stock at 15c. per share.

The Cobalt mining companies are giving more attention to the Gowganda and Elk Lake silver-bearing area where promising results continue in the exploration of numerous prospects.



ARIZONA

Kingman.—Messrs. Downer, King, and Clark of Tonopah have taken over the Estaleah-Cerbat Silver Mining Co.'s property in the Cerbat district on behalf of the Divide Mining Co. Extensive development work is being planned. A considerable amount of development was done by the old company and a large tonnage of lead-silver ore was shipped from the upper workings, some of the shipments assaying 68 % lead, \$30 gold, and 35 oz. silver.

A 4-ft. orebody on the 300-ft. level of the Senate silver mine has been opened. This development proves the continuity of the orebody to that depth. The vein varies in width from 3 to 9 ft., and a large tonnage of ore was taken from the surface years ago. The 300-ft. level of the Senate corresponds to the 400-ft. level of the Hackberry Consolidated from which ore is being shipped containing 200 to 300 oz. silver per ton.

The drift on the 300-ft. level of the Telluride mine at Oatman is now in ore assaying \$30 in gold over a width of 30 in. To date a length of 100 ft. has been proved and the ore continues to improve as progress is made.

Mayer.—The Rebel and Kicker claims adjoining the Gladstone have been purchased by the United American Copper Co. These claims were owned and operated by the Amalgamated Copper Co. in the 'eighties. They have been leased from time to time, development having been carried to the 200-ft. level. A large number of profitable shipments have been made. A power plant, hoist, and compressor are to be installed at once.

The Arizona Copper & Mining Co. is installing newer and larger equipment on the Pentland mine. Development work has now reached a depth of 800 ft. and preparations are being made to mine and ship ore from the 500 and 600-ft. levels.

CALIFORNIA

Nevada County.—The Penn-California Mining Co., of Pittsburgh, Pennsylvania, owner of 15 properties approximating 1000 acres, is still driving its tunnel into the hill, having already penetrated 1000 ft. of hard granite. Another 200 ft. will probably be necessary before raising into the ore-channel. The tunnel was surveyed by E. C. Uren, and is 5½ by 7 ft. in the clear with a 6 % grade. A 15-stamp mill has been completed near the tunnel outlet. The officers of the company are: Charles L. Walther, president; A. W. Hoge, first vice-president and general manager; W. H. Ketchum, second vice-president.

Sierra County.—It is reported that James F. Hunt has organized a company to operate the Oxford mine near here, and plans to start work at once. A tramway will be built to the Gold Bluff mill, where the ore will be crushed. Two Gibson mills will be installed to re-grind the tailing from the mill, and take the place of concentrators. Work will begin at the apex of the vein.

COLORADO

Mayday.—Fred Brandiger and Geo. W. Avery have opened up a new orebody at the Idaho. The vein is said to be three feet wide and to assay on an average \$50 per ton in gold.

A carload has been taken out ready for shipment to the smelter.

The Idaho shut-down four years ago, when its ore was said to have been exhausted, after a record as a steady shipper of high-grade ore. Several carloads shipped from the dump during the past summer assayed from \$32 to \$50 per ton. The Idaho has produced approximately \$2,500,000.

IDAHO

Coeur d'Alene.—The Montana-Idaho Copper Co., engaged in a large development enterprise near Adair, has suspended operations because of a shortage of water, according to W. J. Kirby, secretary-treasurer. The company has operated continuously for the last four years and will resume when conditions permit.

The Caledonia Mining Co. has declared its usual monthly dividend of \$26,050, according to Stanly A. Easton, president. This is at the rate of 1c. per share on an issue of 2,605,000 shares. Payment will be made January 5. The forthcoming payment will increase the total of disbursements to \$4,011,700.

The Consolidated Interstate-Callahan company shipped 5,825,389 lb. of zinc concentrate in November last. It shipped 2,164,908 lb. of lead concentrate and 20,017 oz. of silver in the same month. This showing was due to improved methods of handling and the oil-flotation system of metal recovery, according to report.

Latah County.—Five feet of chalcopryrite ore, averaging 10 % copper, has been struck by the Merger Mining Co. in a shaft 30 ft. deep, according to E. R. Northrup, secretary. The vein at this point has been cross-cut 11 ft. without disclosing the foot-wall. Six feet of the vein toward the foot-wall will average 2 % copper.

Shoshone County.—"In recent months we have put many additional tons of ore in sight by drifting on the vein, principally on the 700-ft. or old No. 2 tunnel level," is the statement of Henry H. Armstead, president of the Armstead Mines. "On this level the vein has been opened at points 1600 ft. apart principally by drift, but partly by cross-cuts. The campaign for the winter includes drifting on the vein at points north and south from the raise and a continuance of the raise for 150 ft. above its top. The raise is about 600 ft. long and connects the No. 3 and 2 tunnels.

MONTANA

Butte.—The Anaconda Copper company has declared a dividend of \$1 per share, payable February 24 to stockholders of record January 17.

NEVADA

Hawthorne.—We are informed by John B. Platts, superintendent, that a large body of minable ore has recently been opened in the old Sunrise mine, now called the Silver Dollar, situated about 20 miles south of Hawthorne. After sorting and shipping some high-grade ore 40 years ago the mine was closed down and allowed to cave. It was not re-opened until this year when the Oro Zona Mines Co. acquired the property and cleaned out the old workings. Cleaning out an old mine is a risky undertaking because the traditional rich

ore in the bottom is seldom there. In this case the operators were agreeably surprised to find a large body of paying ore almost untouched except for the development work. The ore contains gold, silver, and some lead, is 6 ft. wide, and the shoot is nearly 1000 ft. long. The shaft is a little over 100 ft. deep with good ore in the bottom.

Ploche.—The Prince Consolidated Mining Co. is speeding the sinking of the new shaft to the orebodies below. For the past two weeks an average advance of 5.8 ft. per day has been made in the deepening of the big working shaft, which has now reached a total depth of 475 ft. The water-level is still 70 ft. deeper, but at the present rate of progress it should be reached soon. A large station will be cut at the water-level to accommodate the pumps and other necessary equipment to continue work. The installation of the sterling boilers will be completed by January 15. All the necessary adjuncts to the pumping and power installations should also be completed by that time. A sub-track bin for coal is being built and the coal will be transferred from this track-bin to the big storage-bin, situated at the boiler plant, by a wide conveyor-belt.

OKLAHOMA

Quapaw.—The Charlotte Lead & Zinc Co. is just completing a new 150-ton mill on its lease two miles east of Quapaw, and will begin operation early in January. The mill is of 150 tons capacity, equipped with gas engines. Gas and steam equipment have been furnished for the underground work.

Two shafts have been sunk into ore, which was encountered at 85 ft., being about equal in lead and zinc value. I. M. Holcomb of Oklahoma City is president of the company. The Lead Boy Mining Co. is preparing to resume operations at its Lead Boy mill, two miles east of Quapaw, immediately after the first of the year. The mill has been closed down for the past three or four months, but has been cleaned up and put in first-class condition for steady work in 1920. It is a 150-ton plant.

WASHINGTON

Spokane.—Special interest attaches to the annual convention of the Northwest Mining Institute in Spokane, February 16-21, as the 'flu ban' prevented the annual gathering in 1919. An exceptionally good program has been arranged, including special days for Idaho, British Columbia, and Washington.

Work of a permanent character has been done on the Gladstone Mountain mine, Northport district, recently, according to Dan D. Dodd, superintendent. The company has 100 tons of clean ore on the dump.

L. Oriard and associates of Marshall are working the Goldenrod mine near Chesaw and will ship their first car of ore shortly. This ore averages \$40 in gold, \$11 in silver, and \$3 in lead, and is hauled six miles to the railroad and then shipped to the smelter at Northport.

J. A. MacLean, owner of the Roosevelt mine on Copper mountain, near Chesaw, has closed a contract with the Northwest Magnesite Co., Chewelah, to ship 2000 tons of magnetic iron ore from his property there. Delivery to the Chesaw spur will be made by two motor-trucks handling five tons each per trip.

The Electric Point Mining Co. expects to make 1920 the banner year in volume of production. The best year of the Electric Point was 1917, when it shipped 16,310 tons and after disbursing \$158,700 in dividends had a surplus of \$200,000. Since 1917 the company has installed a tramway more than two miles long that eliminates a hard and dangerous wagon haul of several miles. The tramway will handle 200 tons per day with ease and can handle 500 tons daily under pressure, according to a recent statement of the builders.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Jay P. Graves is at Pasadena.

R. C. Gemmell is in San Francisco.

F. A. Goodale has gone to Australia.

W. J. Elmendorf was recently at Sandon, B. C.

Charles A. Banks, of Vancouver, is on his way to London.

Theodore J. Hoover has returned to Palo Alto from New York.

L. W. Lennox has returned to Cripple Creek by way of Los Angeles.

F. W. Holler is superintendent of the Surf Inlet mine in British Columbia.

W. D. Thornton was here from New York during the Christmas holidays.

S. M. Levy, manager for the Calaveras Copper Co., has returned from New York.

Charles F. Willis has become editor of the 'Arizona Mining Journal', published at Phoenix.

G. M. Colvocoresses, manager of the Humboldt smelter, near Prescott, Arizona, has been in New York.

Andrew W. Newberry has opened on office at 66 Broadway, New York, as consulting mining engineer.

Fred. B. Mechling, of Tonopah, was in San Francisco on his return from the Yale district in British Columbia.

W. W. J. Croze, manager of the geological department of the Oliver Iron Mining Co., at Duluth, Minnesota, has gone to Brazil.

P. G. Beckett has been promoted to general manager for the Phelps Dodge Corporation, with headquarters at Douglas, Arizona.

Norman N. Blye, superintendent of the Silver King Consolidated mine at Park City, Utah, spent the holidays at Los Angeles.

Arthur W. Jenks has just returned from Oregon and Idaho, where he has been making a series of examinations for Portland clients.

Herbert S. Shuey, secretary to the Merrill Company, of San Francisco, was married on December 26, to Miss Florence McAvoy, of Boise, Idaho.

J. C. Lane, superintendent of the Kennecott Copper Corporation's milling plant in Alaska, is visiting metallurgical plants in Utah, Nevada, and Arizona.

Sumner S. Smith, of the U. S. Bureau of Mines, was in San Francisco on his return from Anchorage, Alaska. He is now examining coal-cleaning plants in New Mexico.

Charles W. Adams, recently appointed general manager of the East Helena plant of the A. S. & R. Co., was married to Miss Mary Crowley at Salt Lake City on December 26.

J. Harry Hughes, of Mobile, Alabama, who served in France with the Rainbow Division, has become assistant superintendent for the Ranier Mines Corporation, at Wenden, Arizona.

E. W. Engelmann has been appointed to the position of consulting research engineer for the Utah Copper, Chino Copper, Ray Con. Copper, and Nevada Con. Copper companies, with headquarters at Salt Lake City.

Charles Keith Blackwood, vice-president, assistant treasurer, and a director of the Sullivan Machinery Co., died in Chicago on December 14. His sound financial judgment, keen foresight, and executive ability, had been important factors in the Sullivan company's growth during the past seventeen years, where he was a valued associate and loyal friend.

THE METAL MARKET



METAL PRICES

San Francisco, December 30

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10.00
Copper, electrolytic, cents per pound.....	10.00
Lead, pig, cents per pound.....	7.75-8.75
Platinum, pure, per ounce.....	\$150
Platinum, 10% iridium, per ounce.....	\$180
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	10.00
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

December 30.—Copper is active and higher. Lead is strong and advancing. Zinc is active and higher.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York			London	Average week ending			
	Date	cents	pence		Cents	Pence	
Dec.	24	133.50	77.12	Nov.	18	125.73	68.81
"	25 Holiday			"	25	131.93	73.46
"	26	133.00		Dec.	2	132.00	73.50
"	27	132.50		"	9	131.29	74.75
"	28 Sunday			"	16	131.29	77.38
"	29	132.50	76.25	"	23	133.56	78.08
"	30	131.50	76.25	"	30	132.50	76.87

Monthly averages							
	1917	1918	1919		1917	1918	1919
Jan.	75.14	88.72	101.12	July	78.92	99.62	106.38
Feb.	77.54	85.79	101.12	Aug.	85.40	100.31	111.35
Mch.	74.13	88.11	101.12	Sept.	100.73	101.12	113.92
Apr.	72.51	95.35	101.12	Oct.	87.38	101.12	119.10
May	74.61	99.50	107.23	Nov.	85.97	101.12	127.57
June	76.44	99.50	110.50	Dec.	85.97	101.12	

COPPER

Prices of electrolytic in New York, in cents per pound.

Date			Average week ending	
Dec. 24	18.75		Nov. 18	21.36
" 25 Holiday			" 25	19.48
" 26	18.75		Dec. 2	18.55
" 27	18.87		" 9	18.21
" 28 Sunday			" 16	18.50
" 29	19.00		" 23	18.75
" 30	19.25		" 30	18.92

Monthly averages							
	1917	1918	1919		1917	1918	1919
Jan.	29.53	23.50	20.43	July	29.67	26.00	20.82
Feb.	34.57	23.50	17.34	Aug.	27.42	26.00	22.51
Mch.	36.00	23.50	15.05	Sept.	25.11	26.00	22.10
Apr.	33.16	23.50	15.23	Oct.	23.50	26.00	21.66
May	31.89	23.50	15.91	Nov.	23.50	26.00	20.45
June	32.57	23.50	17.53	Dec.	23.50	26.00	

LEAD

Lead is quoted in cents per pound. New York delivery.

Date	New York		London		Average week ending	
Dec. 24	7.35	7.35	Nov. 18	6.80	6.80	6.80
" 25 Holiday			" 25	6.75	6.75	6.75
" 26	7.45	7.45	Dec. 2	6.75	6.75	6.75
" 27	7.50	7.50	" 9	6.82	6.82	6.82
" 28 Sunday			" 16	6.88	6.88	6.88
" 29	7.62	7.62	" 23	7.26	7.26	7.26
" 30	7.75	7.75	" 30	7.53	7.53	7.53

Monthly averages					
1917		1918		1919	
Jan.	7.64	6.85	5.80	July	10.93 8.03 5.53
Feb.	9.10	7.07	5.13	Aug.	10.75 8.05 5.78
Mch.	10.07	7.26	5.24	Sept.	9.07 8.05 6.02
Apr.	9.38	6.99	5.05	Oct.	6.97 8.05 6.40
May	10.29	6.88	5.04	Nov.	6.38 8.05 6.76
June	11.74	7.59	5.32	Dec.	6.49 6.90

TIN

Prices in New York, in cents per pound:

1917		1918		1919		1917		1918		1919					
Jan.	44.10	85.13	71.50	July	62.60	93.00	70.11	Feb.	51.47	85.00	72.44	Aug.	62.53	91.33	62.20
Mch.	54.27	85.00	72.50	Sept.	61.54	80.40	55.79	Apr.	55.63	88.53	72.50	Oct.	62.24	78.82	54.82
May	63.21	100.01	72.50	Nov.	74.18	73.67	54.17	June	61.93	91.00	71.83	Dec.	85.00	71.52	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	24	pence			Average week ending	
Dec.	"	24	8.70	Nov.	18.	8.28
"	"	25	Holiday	"	26.	8.16
"	"	26	8.85	Dec.	2.	8.31
"	"	27	8.97	"	9.	8.58
"	"	28	Sunday	"	16.	8.03
"	"	29	9.10	"	23.	8.66
"	"	30	9.35	"	30.	8.99

Monthly averages							
	1917	1918	1919		1917	1918	1919
Jan.	9.75	7.78	7.44	July	8.98	8.72	7.78
Feb.	10.45	7.97	6.71	Aug.	8.58	8.78	7.81
Mch.	10.78	7.67	6.53	Sept.	8.33	9.38	7.57
Apr.	10.20	7.04	6.40	Oct.	8.32	9.11	7.82
May	9.41	7.92	6.43	Nov.	7.78	8.75	8.12
June	9.63	7.92	6.91	Dec.	7.84	8.49	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			Dec.	16.		100.00	
"	2	85.00	"	23.		95.00	
"	9	100.00	"	30.		85.00	
Monthly averages							
	1917	1918	1919		1917	1918	1919
Jan.	81.00	128.00	103.75	July	102.00	120.00	100.00
Feb.	126.25	118.00	90.00	Aug.	115.00	120.00	103.00
Mch.	113.75	112.00	72.80	Sept.	112.00	120.00	102.60
Apr.	114.50	115.00	73.12	Oct.	102.00	120.00	86.00
May	104.00	110.00	84.80	Nov.	102.50	120.00	78.00
June	85.00	112.00	94.40	Dec.	117.42	115.00	85.00

MONEY AND EXCHANGE

There have been persistent rumors that 'something was being done' to improve the European exchange situation. These reports have been lent color by a slight recovery in the sterling rate during the last few days. But investigation fails to uncover the existence of any new steps along this line, other than those already planned or outlined and which are being held in abeyance pending formal termination of the War. The Far Eastern exchange problem is less difficult and action intended to stabilize rates in the Orient are being taken.

Three million silver dollars were shipped from San Francisco to China on Christmas Day. Consignment is being made on joint account by the International Banking Corporation, Park Union Foreign Banking Corporation, and Asia Banking Corporation. It is the first shipment which these institutions have forwarded to the Orient under the arrangement they have recently entered into with the Government for the purpose of stabilizing Far Eastern exchange and conserving this country's supply of gold. In accordance with the terms of agreement, the silver dollars have been procured against the tender of current funds from the free supply carried by the Government in its general fund. That the silver pieces are being sent intact, without first being melted down into bars, is due, for one thing, to the approach of the Chinese new year, which begins February 1. This date in the Chinese calendar is the general settlement period, and the Chinese money market usually experiences considerable hardening.

The present shipment is not the first consignment of silver dollars to China. Before the Government embarked on its present policy of selling silver dollars to the three institutions named above, an aggregate of 12,000,000 silver dollars had been forwarded to China on strictly private account, 3,000,000 on November 25 and 9,000,000 on December 10. Among the shippers of these earlier consignments were the International Banking Corporation, which initiated the movement, the Hongkong & Shanghai Bank, the Equitable Trust Co., and the Chartered Bank of India.

A rather interesting feature connected with these consignments is the fact that the silver dollars were obtained from the San Francisco sub-treasury against the payment of current funds. Except under the plan now in operation, silver dollars can ordinarily be procured from the Government only against the presentation of silver certificates. But after some negotiations with the Washington authorities bankers succeeded in securing silver dollars, against the tender of current funds, from the stock carried by the general fund. This explains the reduction in the amount of free silver dollars held by the Government from 67,000,000 in the latter part of November to 52,000,000 on December 11.

Large amounts of silver bullion have also been forwarded from this country to China during the past several weeks. Bankers are inclined to anticipate a subsidence in the movement, if not a total cessation, in the not distant future. Future dollar exchange in Shanghai, for delivery about the first of February, which is usually the form of remittance to this country, purchased in Shanghai against shipments of the white metal from the United States, is already quoted below the export parity, and with the approach of the Chinese new year, it would not be surprising if a further decline should occur in the rate, particularly if silver continues to maintain its present strength in this market.

Foreign exchange quotations on December 30 are as follows:

Sterling, dollars:	Cable	3.78 1/2
	Demand	3.78 1/2
Francs, cents:	Cable	8.33
	Demand	8.33
Lire, cents:	Demand	7.60
Marks, cents	Demand	2.15

Eastern Metal Market

New York, December 23.

All the markets are generally quiet as is usual at this season. Sterling exchange values still are a prominent factor in determining prices of some metals.

The copper market is very quiet but steady.

Tin prices fluctuate with the changes in the pound sterling. Buying has been lighter than for some weeks.

Lead is the strongest of all the markets and prices are still advancing.

The zinc market has turned quiet and prices are slightly easier but steady.

Antimony is quiet and unchanged.

IRON AND STEEL

The end of 1919 witnesses steel mills still guarding against overloading their books. Some companies which have been refusing business since the beginning of the coal strike now have capacity open for the first quarter of 1920, but the element of cost uncertainty still exists as an undetermined factor. Quoting high prices has been purposely done to discourage business. Semi-finished steel is hard to obtain. Steel and iron production in the leading centres varies but little from that of recent weeks, the coal supplies not having increased to the extent indicated by reports from some mines. Expectation of considerable railroad business after January 1 is general and for rails alone orders running up to 800,000 to 1,000,000 tons are not improbable in 1920. Output of automobiles is still limited by the non-delivery of sheets and one large Detroit company has had to curtail 50%.

COPPER

The market has been quiet but sales are reported to have been fairly substantial, some of them to foreign countries. Japan has been again a heavy buyer. Prices have undergone little change. Electrolytic copper for December and January delivery is steady at 18.75 to 19c., New York, with Lake copper at about 19 to 19.25c., New York. One large producer is reported as stating that sales in the last 60 days have been exceedingly large, while another authority asserts that between 250,000,000 and 300,000,000 lb. were contracted for this month, of which about 50,000,000 lb. is for export. Domestic business has been largely for December and first quarter of 1920, although some business is reported to have been booked for second quarter. Besides Japan, purchases have been made by Great Britain, France, Italy, and some by Germany, with the Scandinavian countries also buyers.

TIN

Conditions have changed but little from those obtaining a week ago. The market has been generally quiet. Less metal has been sold than during last week but price fluctuations have been erratic. Sterling exchange continues the predominating factor. Prices for spot tin are changing each day with the variations in the rate of exchange. As the result of a higher value to the pound sterling yesterday and also a much higher London market, spot Straits tin was quoted yesterday at 55.50c., New York. In London spot Straits was £325 5s. per ton, or an advance over the previous day of £2 17s.6d. With the value of the pound at \$3.80 this makes the London price of spot Straits about 55.25c. per lb. and not far from the American market. Because of the difficulty in obtaining future exchange there has been no buying or even quoting on future shipments. American pure tin is quoted at 54.25c. with the 99% grade at 54c.

Arrivals thus far this month have been 4928 tons, of which 1190 tons is credited to Pacific ports. The quantity afloat is 3175 tons.

LEAD

"Exceedingly strong"—says a leading lead broker. It is the strongest of any of the non-ferrous metals. On December 18 the American Smelting & Refining Co. again advanced its price from 7 to 7.15c., New York, and 6.85 to 6.90c., St. Louis. The tendency is decidedly upward and, while some regard the price as too high now, it is acknowledged that it may go higher. A pronounced scarcity as well as a good demand are two of the causes of the present high prices and there is also the factor of higher values abroad as well as less metal for importation. The London market yesterday was £43 15s. per ton for spot lead or £20 higher than six months ago. The outside market, which at present represents values, is quite a little higher than the Trust. Today lead has sold as high as 7.35c., New York, or 7.10c., St. Louis, which we quote as the market. Production generally is reported as better and it is expected that this will be felt in lower prices by March 1920.

ZINC

Despite the fact that there has been quite a lapse in foreign buying and no increase in domestic demand, which has been light for some time, the market remains steady. The strength is evidenced by the fact that producers are comfortably sold up as far ahead as desired and are not pressing the market. The speculative position is also very favorable. Prime Western for early and first quarter delivery is quoted at 9.30c., St. Louis, or 8.65c., New York. The London market has advanced very recently but owing to the wide changes in sterling exchange buying for British account has been checked. The London market was quoted yesterday at £53 15s. per ton, which is about 9c. per lb. at the present value of the English pound in American dollars.

ANTIMONY

No changes are recorded. Wholesale lots for early delivery are quoted at 9.62½c., New York, duty paid, with demand light.

ALUMINUM

For the best grades of virgin metal, 98 to 99% pure, quotations are nominal at 32 to 33c., New York, for wholesale lots for early delivery.

ORES

Tungsten: The market is dead and is expected to remain so until early in 1920 at least. Quotations are purely nominal at \$7 to \$15 per unit, depending on the grade of ore. Business in ferro-tungsten, if any, is probably a matter of negotiation as no open market quotations are heard of. Values are probably around \$1 to \$1.15 per lb. of contained tungsten.

Molybdenum: Conditions are unchanged and quotations are nominal at about 75c. per lb. of MoS₂ in regular concentrates.

Manganese-Iron Alloys: American producers of ferro-manganese have advanced their quotations to \$130, delivered, or \$10 over the recent price at which a heavy business was done. The only British alloy known to be available is 1000 tons for second quarter at \$120, seaboard. None of this is reported sold thus far, it having been before the market a week ago. Another British seller has a nominal authorized asking price of \$125, seaboard. Spiegeleisen is strong but quiet at \$40, furnace.



Copyright 1920, by The Goodyear Tire & Rubber Co., Akron, O.

Efficient Partner of the Tool on All Pneumatic Work

Nearly every job for pneumatic tools demands that the air hose be capable of withstanding rough usage, and one of the qualities of Goodyear Monterey Air Hose is its high resistance to abrasion.

Combining lightness with strength, Goodyear Monterey Air Hose also is easily handled under awkward working conditions.

Besides, Goodyear Monterey Air Hose offers successful resistance to the rotting action of oil.

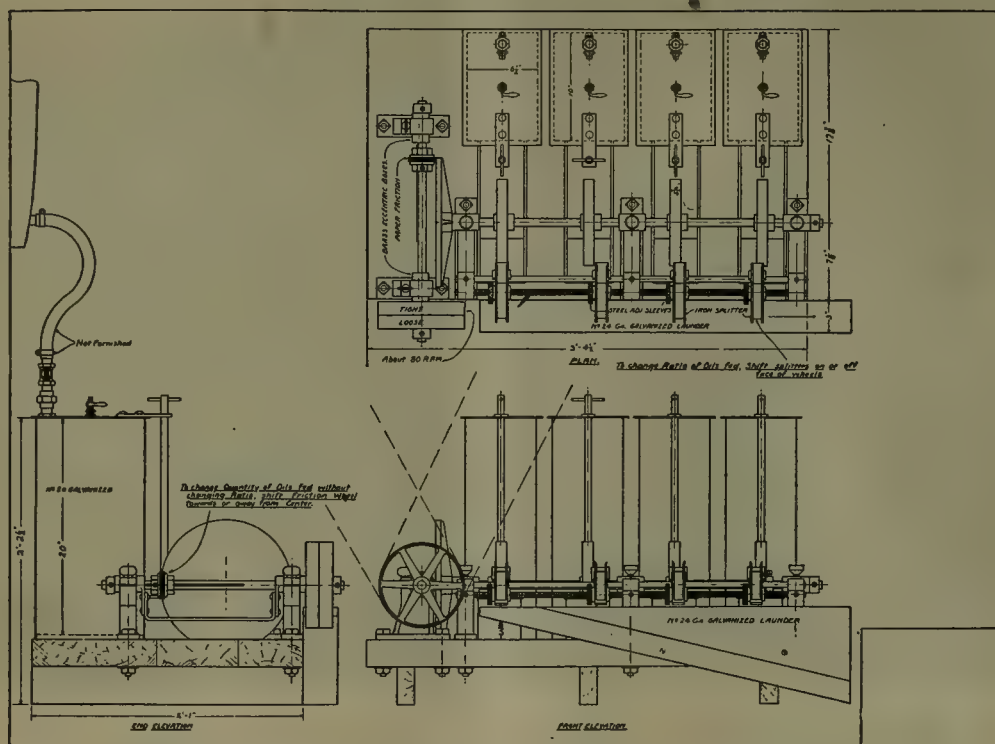
Made of new, live rubber, specially compounded for this service, and of stout fabric construction, every element in Goodyear Monterey Air Hose works for full delivery of the pressure, together with freedom from kinks, cracks and bursts.

Long-lived, and dependable from first to last, Goodyear Monterey Air Hose has a notable record for operating economy in all fields of pneumatic tool service.

THE GOODYEAR TIRE & RUBBER CO.

Offices Throughout the World

BELTING • PACKING HOSE • VALVES
GOODYEAR



OIL FEEDER FOR FLOTATION CELLS

The above cut illustrates our special type oil feeder for feeding four or more different oils or flotation reagents in their respective quantities as desired.

This oil feeder has been used in a large number of plants for some years, and has always given satisfaction.

It is very easy to regulate; remains constant when once set; has a wide field of adjustment and handles coal tar products as easily and efficiently as the lighter pine oils.

We also have a similar type of device for feeding acids.

Write for further particulars.

Ask for the Fourth Edition of our Testing Bulletin.

THE GENERAL ENGINEERING CO., Inc.

J. M. CALLOW, President

SALT LAKE CITY, UTAH, U. S. A.

120 Broadway, New York

363 Sparks Street, Ottawa, Ontario

UNION CONSTRUCTION COMPANY

SPECIALISTS in PLACER MINING EQUIPMENT for GOLD, TIN and PLATINUM



Union Dredge No. 19—oil-engine driven—operating on Bangor Creek, near Nome, Alaska. Has $3\frac{1}{2}$ cubic foot buckets, digs 50 feet below water level, and has made an average of 2000 yards per day.



Union Dredge No. 18, operating on Mastodon Creek, near Circle City, Alaska; $3\frac{1}{2}$ cubic foot dredge driven by steam locomobile engines, using an average of $4\frac{1}{2}$ cords of wood per 24 hours. This dredge has made an enviable record of 3100 cubic yards per day for a period of 17 days.

UNION GOLD DREDGES

are the result of years of concentrated effort and study. Wide experience in the design, manufacturing and operating of dredges enables us to produce apparatus built to fit any condition for working placer or mineral deposits.

We invite correspondence. Put your dredging problems up to us. The service of our experts is at your disposal.

UNION CONSTRUCTION COMPANY

UNION DREDGES -- UNION DRILLS -- THE NEILL JIG

604 Mission St., San Francisco

Standard Works *offered in* Combination



Act Now—

Six standard books, the latest editions, and the best in their fields, in combination with subscriptions to the MINING AND SCIENTIFIC PRESS at prices effecting a substantial saving over the retail prices. These prices effective Nov. 15, 1919, and subject to change without notice.

ONE COMBINATION OFFER ONLY FOR EACH SUBSCRIPTION

Mining Engineer's Handbook

By ROBERT PEELE

2375 Pages, Index

This splendid handbook contains no discussion of abstract theory. Nothing but facts are found within its covers; not a surplus word, nothing of any consequence is omitted. It is a veritable encyclopedia.

Price \$ 6
Mining and Scientific Press one year. 4
\$10

Special Price for Both,
in Combination

\$9

Mineralogy, Blowpipe Analysis, and Crystallography

By G. M. BUTLER

546 Pages, Index

This is a handbook, just the thing for the pocket of the field man as a reference work, and equally valuable on the desk of the busy consulting engineer, mine manager and assayer. It is thorough, practical and confined to essentials.

Price \$3.50
Mining and Scientific Press one year. 4.00
\$7.50

Special Price for Both,
in Combination

\$6.50

Timber Framing

By H. D. DEWELL

275 Pages, Index

This book contains design and construction of head-frames, flumes, ore-bins, treatles, water-towers, mill-buildings and, in fact, all building incident to mining operations. A book for reference and study for those connected with construction work.

Price \$2.50
Mining and Scientific Press one year. 4.00
\$6.50

Special Price for Both,
in Combination

\$5.50

Technical Methods of Ore Analysis

By ALBERT H. LOW

374 Pages, Index

This is the seventh edition of this standard work, and is the last word on this subject. The chemist, mining engineer, assayer, and everybody concerned in the determination of the economic value of ores will find this book of great value.

Price \$8.25
Mining and Scientific Press one year. 4.00
\$12.25

Special Price for Both,
in Combination

\$6.50

Hydraulic and Placer Mining

By EUGENE B. WILSON

425 Pages, Index

This is the third and last edition (1913) and covers the essentials of the entire placer mining field. It is thorough, practical and gives due consideration to the apparatus employed. It is an invaluable reference book, and equally useful to those who desire to add to their knowledge of this branch of mining.

Price \$3.50
Mining and Scientific Press one year. 4.00
\$7.50

Special Price for Both,
in Combination

\$6.50

Mechanical Engineer's Pocket Book

By WILLIAM KENT

1526 Pages, Index

The standard mechanical engineers' reference book covering every conceivable phase of the profession, a veritable encyclopedia in itself.

Price \$ 6
Mining and Scientific Press one year. 4
\$10

Special Price for Both,
in Combination

\$9

MINING AND SCIENTIFIC PRESS,
420 Market St., San Francisco

USE THE COUPON

Add \$1.00 for Canadian Postage
\$2.00 for Foreign Postage

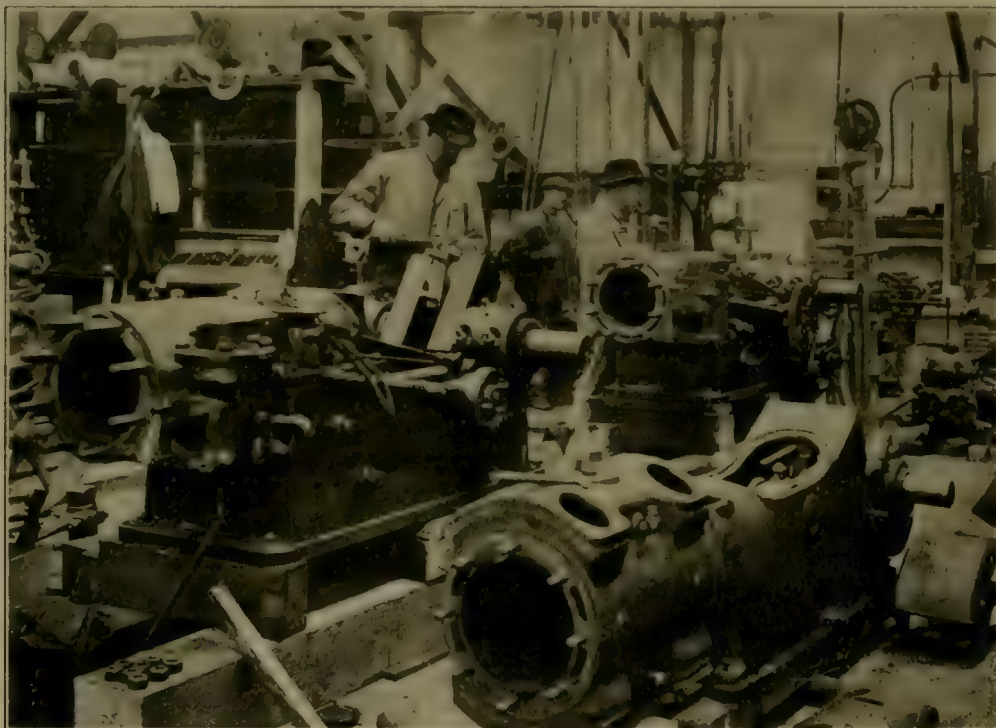
Enclosed find \$.....

Please enter my subscription to the MINING and Scientific PRESS.

Please send me a copy of

Name Vocation

Address Company employed by



REBUILDING EQUIPMENT

— FOR —

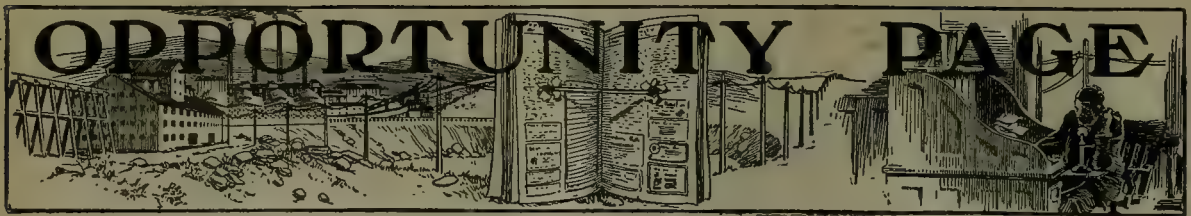
DIVIDE DISTRICT, NEVADA

2—60 H. P. Western Distillate Engines
1—50 H. P. Western Distillate Engine
1—35 H. P. Western Distillate Engine
1—20 H. P. Fairbanks Type Y Oil Engine
1—12 x 12 WG4 Sullivan Compressor
1—16 x 10 x 16 WH2 Sullivan Compressor

This is standard practice with all used machinery sent out by

A. H. SIMPSON COMPANY

129 FREMONT STREET, SAN FRANCISCO



OPPORTUNITIES

Under this heading announcements may be made of new and second-hand machinery or supplies, for sale or wanted. The cost is five cents per word, including address. Minimum charge one dollar per insertion. Remittances MUST accompany order. Copy must be received by Saturday for the following week's issue.

A SUBSTANTIAL INTEREST in proven mine on California mother lode is available at extremely low price to assayer and surveyor or mining engineer willing to work for moderate salary during development stage. Address P. O. Box 772, San Jose, Cal. 1f

PLACER GOLD PROPERTY? I know of a good one; have been working with the owner for years to get him in frame of mind to lease it; no gamble; will stand strictest investigations. Am now looking for man with money to install equipment. Gravel lies on hillside and water is available. This is a first-class hydraulic proposition. Address Mr. Czarra, Cantil, 132 Lack Bdg., San Francisco. 1-3

OPPORTUNITY—Diamond drilling on a new basis of cost, saving you one-half to one-quarter over present methods. Guaranteed work with best up to the minute equipment, efficient and experienced help. Long experienced and enthusiastic customers. Write for information. H. D. Staley, 132 Lack Bdg., San Francisco. 1f

WANTED—Lead, silver or gold property; Southwest preferred; must have sufficient tonnage in sight to justify installation of mining and milling machinery. Will take in owners as partners if desired. Send full details in first letter. Address Opp. 212, Mining and Scientific Press. 1-24

EXCELLENT SILVER-GOLD PROSPECTS for sale or trade. Write for reports and liberal terms. Address Opp. 213, Mining and Scientific Press. 1-3

MINING AND SCIENTIFIC PRESS wants a permanent circulation representative in every mining community in the world. Replies will be held confidential if desired. Address, The Manager, Mining and Scientific Press

IMMEDIATE SHIPMENT FROM NEW YORK STOCK

3 MINE CAGES for vertical shaft, designed to carry mine car with 1800 lb. of ore; outside measurement of platform 4 ft. 2 in. long, guides 4 in. x 4 in. and 2 ft. 11 in. apart; platform of grating and with track for 50 centimeter gauge.

8 MINE CARS, rotary dump, with roller bearing wheels and axles; capacity 1800 lb. of ore; total height 42 in.

All of the above are new and packed for export shipment.

An opportunity to obtain quick shipment at low price.

THE MINE AND SMELTER SUPPLY CO.

42 Broadway, New York 1f

BLAKE, MOFFITT & TOWNE DEALERS IN PAPER

87 TO 45 FIRST STREET, SAN FRANCISCO, CAL.

BRANCH HOUSES IN LOS ANGELES AND PORTLAND

FOR SALE

MILLING MACHINERY

BLAKE CRUSHERS

- 1—5x30 Blake Challenge
- 1—4x10 Blake
- 1—7x10 Blake
- 1—7x10 McFarlane
- 1—7x10 Hendy & Meyer
- 2—9x15 Farrell Blake
- 1—9x15 McFarlane
- 1—9x15 Allis-Chalmers
- 1—10x20 Davis Iron Wks.
- 1—10x20 Allis-Chalmers
- 1—13x24 McFarlane
- 1—15x24 Power & Mining Mch. Co.

Extra Shafts for Blake Crushers
Sizes 7x10 to 15x24

DODGE

- 2—4½x6 McFarlane
- 1—4½x6 McFarlane (New)
- 1—6x8 Dodge
- 1—7x10 Dodge
- 1—7x10 Davis Iron Wks.
- 1—9x15 McFarlane

GYBATORY

- No. 1 Gates
- No. 3 Austin
- No. 5 Austin

MISCELLANEOUS CRUSHERS

- 1—7x15 Forsyth
- 1—7x16 Samson
- 1—No. 3 Samson
- 1—No. 4 Samson
- 1—Size B Samson
- 1—No. 10 Symons

CRUSHING ROLLS

- 1—6x9 Parallel Sampling
- 1—10x14 McFarlane
- 3—12x20 McFarlane
- 1—14x27 Colorado Iron Wks.
- 1—14x27 Walker
- 2—14x27 Davis
- 2—14x30 Power & Mining Mch.
- 1—14x36 Allis
- 1—18x36 McFarlane
- 1—18x36 Power & Mining Mch.
- 1—18x36 Walker

CLASSIFIERS

- 2—Dorr Simplex
- 3—30" Akins
- 2—Richards Vortex
- 1—20" Allis-Chalmers
- 1—No. 1 Dorr Duplex
- 1—Dorr Simplex

DORE MATERIAL

- 4—18x10 Thickeners
- 1—22x8 "
- 2—24x8 "
- 1—30x10 "
- 3—33x12 "
- 4—36x12 "
- 3—12x10' 8" Agitators
- 3—20x14 "
- 3—20x20 "

FILTERS

- 1—18" Perrin Filter Press
- 1—24" Shriver Filter Press
- 1—6'x8' Portland Filter
- 1—Kelly Filter

TANKS

- 1—Steel Tank, 55,000 gal. capacity, supported by 10 columns of 7" 9.75 channel irons
- 1—122'x8' No. 8 Steel Tank
- 1—34'x6' Storage Tank, ½" thick
- 2—12'x14' Steel Tanks
- 6—14'x4' No. 12 Steel Tanks, capacity 4600 gal.
- 1—14'x3' No. 10 Steel Tank, capacity 3450 gal.
- 1—7'x8' ¾" Steel Tank
- 1—6'x5' 3/16" Steel Tank
- 1—4'x4' No. 12 Steel Tank
- 3—30'x5' Closed Storage Tanks
- 2—18'x5' Acid Proof Tanks
- 1—41'x42'x9' 3" Deep Boiling Tank
- 3—8' Callow Tanks
- 3—18x15x3 Wood Tanks (Oregon Fir)
- 2—18x10x3 "
- 2—16x 6x2 " " " "
- 2—8x 8x3 " " " "
- 1—24'x18' Redwood Tank
- 1—30'x20' Redwood Tank
- 1—20' dia. x 18' deep Redwood Tank
- 1—22'x14' Circular Redwood Tank
- 3—22'x14' Circular Wooden Tanks

Write us your requirements

Morse Bros. Machinery & Supply Co.

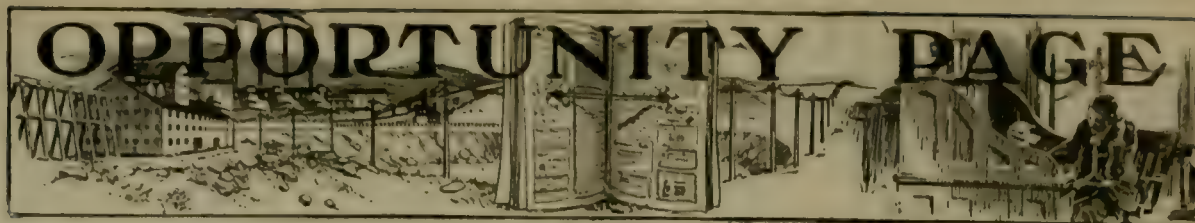
1732 Wazee Street, Denver, Colorado

BUTCHART

Concentrating Tables, Flotation Apparatus, Classifiers, Screens, etc.

W. A. BUTCHART, 1326-1330 Eleventh St., Denver, Colo.
A. P. WATT, Eastern Representative, Room 1903, 52 Vanderbilt Ave., New York

THE STEARNS-ROGER MFG. CO.
ENGINEERS
MANUFACTURERS
CONTRACTORS
— DENVER, COLO. —
MINING AND
MILLING MACHINERY
AND PLANTS



POSITIONS WANTED

The cost of advertising for positions wanted is 2 cents per word, including address. Minimum charge 50 cents per insertion. Replies forwarded without extra charge. Remittances must accompany order. Copy must be received Saturday morning for the following week's issue.

MINING ENGINEER, age 34, single; technical graduate; thoroughly experienced in underground and surface operations, exploration and geological work; good executive; accustomed to handling labor in large units; works situation as superintendent, assistant superintendent or mining engineer; no objection to going abroad. Address PW 222, Mining and Scientific Press. 1-24

AN ENGINEER, thirty-three, technically educated, possessed of common sense, abundant energy and fairly decent personality, thoroughly trained in the business of mining, milling and smelting by eight years experience as mucker, surveyor, draftsman, chief draftsman, mill superintendent and mine engineer, wishes to locate a position where the above qualifications are required. Address PW 221, Mining and Scientific Press. 1-3

BOOKKEEPER, reliable accountant, age 30, for mining and milling industry; timekeeping, cost accounting or any kind of book work; practical experience in mine development work; as an experienced bookkeeper in various lines of business I will give results that pay and please; would like employment about January 1st or 15th. Address PW 219, Mining and Scientific Press. 1-10

ASSAYER AND CHEMIST, also experienced in flotation and leaching; long experience and references. Address P. O. Box 1067, Phoenix, Arizona. 1-24

MINING ENGINEER AND METALLURGIST, technical graduate, age 34, married, open for engagement as superintendent or assistant; ten years varied experience in mining and smelting of copper and lead ores, also as head of research department for large smelter. Address PW 220, Mining and Scientific Press. 1-3

ORE DRESSING EXPERT, complete knowledge all modern methods of recovery, wants executive position near future. Specialty, big tonnage, good extraction at reasonable cost. Now employed in large operations. References galore. Address PW 223, Mining and Scientific Press. 1-17

SALES ENGINEER, with long foreign and domestic experience, wants position; technical education, practical experience; most familiar with mining, milling, cement and allied industries needs. Address PW 224, Mining and Scientific Press. 1-24

ASSAYER AND METALLURGICAL CHEMIST, also experienced in copper and zinc metallurgy, on concentration and preparation of mine and assay maps. Address PW 215, Mining and Scientific Press. 1-10

EXPERT RESEARCH CHEMIST in metallurgical and organic chemistry, rare metals and rare earths, experienced in electrolytic process and electrolytic zinc; dyes, foods and chemistry of materials; 25 years experience. Address PW 216, Mining and Scientific Press. 1-10

SUPERINTENDENT available January 1 desires position. Capable in management of mining or milling operations; have just completed the successful development and operation of a quicksilver property, now closed for the winter; do own engineering if necessary; married; age 29; have A1 references. Address PW 218, Mining and Scientific Press. 1-3

MINING ENGINEER, 43, thoroughly trained and experienced in both technical and business end of mine and mill operation; specialty, efficiency management; open for engagement in executive position. Speaks Spanish fluently; at present in consulting practice; highest references. Address PW 211, Mining and Scientific Press. 1-3

POSITION WANTED by first class millman; 15 years experience, stamps, ball-mills, rolls, crushers, jigs, tables, classifiers, flotation, etc. Good mechanic; long experience silver, lead and zinc ores, also amalgamating and concentrating. References. Address PW 191, Mining and Scientific Press. 1-3

MILLING MACHINERY

for sale at reasonable prices. Complete 300-ton mill with all machinery in first-class condition. Includes crushers, rolls, tube-mills, classifiers, thickeners, tables, compressors, etc. Send for list of material available.

E. A. COLBURN

416 East 10th Ave., Denver, Colorado

2-21

United Filters CORPORATION

KELLY and SWEETLAND PRESSURE FILTERS, AMERICAN CONTINUOUS FILTERS
SWEETLAND'S PATENT METALLIC FILTER CLOTH

65 BROADWAY, NEW YORK

People's Gas Bldg.
Chicago, Ill.

Felt Bldg.
Salt Lake City, Utah

Hollingsworth Bldg.
Los Angeles, Cal.

FOR SALE

- 1—8 x 8 Rix Air Compressor.
- 1—6 x 6 Rix Compressor.
- 1—24" Sturtivant Emery Grinder.
- 2—1000 lb. Ore Cars.
- 1—1500 lb. Ore Car.
- 1—12" Blower.
- 1—30 H. P. Doak Gasoline Engine with clutch attached.
- 2—Ingersoll-Rand Water Liner Jack-hammer Drills, complete with water tanks, hose, etc.
- 1—Set 7" Rolls.
- 1—6 x 6 Jaw Crusher.

USED GUARANTEED MACHINERY OF EVERY KIND AND DESCRIPTION.

JARDINE MACHINERY CO.

Office and Warehouse:

115-125 Main Street, San Francisco, Cal.

POWER MINE PUMPS

- 2¼x9 Aldrich Quintuplex, 50 gpm., 1000' head.
- 6¼x12 Jeanesville Horizontal Triplex, 200 gpm., 750' head.
- 7x12 Aldrich Quintuplex Vertical, 500 gpm., 1200' head.
- 7x12 Aldrich Quintuplex Horizontal, 500 gpm., 500' head.
- 13x12 Aldrich Triplex Vertical, 1000 gpm., 280' head.
- 14x16 Aldrich Triplex Vertical, 2000 gpm., 200' head.
- Allis-Chalmers Beldler, 350 gpm., 750' head, never used.
- 8½x8 Deming Triplex Slope, 325 gpm., 300' head.
- No. 5 Byron Jackson nine-stage Centrifugal with 75-hp. G. E. 3-60-410 vert. motor, 1000 gpm., 190' head or 800 gpm., 250' head. Complete with 7" pipe and rods.
- 8x10 Gould Fig. 1062 Deep Well Triplex. Complete with rods and guides, 275 gpm., 300' head.
- Krogh Centrifugal Sinking Pump, 2½" four-stage with 35-hp. G. E. motor, 3-60-410, 200 gpm., 350' head.
- 5x6 Knowles Duplex Electric Sinking Pump, 175 gpm., 400' head.
- 17 Lane & Bowler four to eleven-stage Centrifugals, 12", 14", 15", and 16" sizes. All practically new.

All of the above ready for immediate shipment and in guaranteed condition. We also have steam mine pumps in all sizes and makes ready for immediate shipment. Send for pump bulletin.

THE MORSE BROS. MACHINERY & SUPPLY CO.
Denver, Colo. 2-7

HENRY B. LISTER,
ATTORNEY AT LAW

Notary Public and Commissioner of Deeds for New York
805 Pacific Bldg., Fourth and Market Streets, San Francisco



POSITIONS AVAILABLE

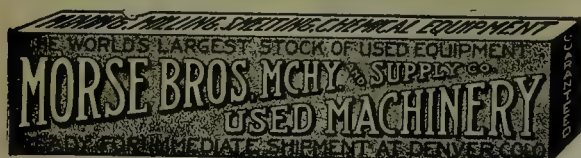
Announcements in this column are secured through the co-operation of many of the largest mining companies in the United States. Advertisements under this heading will be inserted two times without charge. Additional insertions charged at the rate of 2c. per word, including address.

WANTED—HYDRAULIC PLACER FOREMAN to go to Alaska; experienced in northern conditions required; must be able to furnish best references. Address PA 201, Mining and Scientific Press. 1-3

WANTED—PLACER SUPERINTENDENT for hydraulic operations in Alaska; must give satisfactory references and have had experience in the north. Address PA 200, Mining and Scientific Press. 1-3

WANTED—Two mechanical draftsmen experienced in copper smelter work. Large corporation located in the southwest. In replying please state age, experience, married or single, salary desired and when available. Address PA 112, Mining and Scientific Press. tf

POSITIONS secured promptly for well qualified men in all branches of mining and metallurgical work; 16 years established clientele with largest companies in the industry. Business Men's Clearing House, Denver, Colorado. tf



YOU WANT EXPERTS—WE CAN FIND THEM
WE ARE EXPERTS IN OUR LINE—SECURING MEN
MINING—CIVIL—OFFICE—METALLURGICAL



**BUSINESS MEN'S
CLEARING HOUSE**
CHAMBER OF COMMERCE BLDG.

DENVER, COLORADO.

Geologists
Mine and Mill Supts., Foremen
Mine Surveyors
Assayer Chemists
Master Mechanics

Smelter Supts.
Metallurgists
Electricians
Draftsmen
Accountants



FOR SALE

CORDITE M. D. No. 8

11 inches long, as used for 18 pounder ammunition.

Nitro Cellulose (N. C. T.)

seven perforations, granular, as used for 6 inch and 8 inch howitzer ammunition.

QUANTITY—approximately 4,500 tons.

LOCATION—in Ontario.

VALUE—for the manufacture of blasting powder or other commercial explosives, it offers a most attractive purchase.

Full information can be obtained from

IMPERIAL MUNITIONS BOARD (CANADA)

80 KING STREET EAST, TORONTO, ONTARIO, CANADA



"NEVER
JAR
LOOSE"



WRITE
FOR
SAMPLE

DRAKE LOCK-NUT CO.
Cleveland, O. San Francisco, Cal.

Immediate Shipment from Our San Francisco Stock

JOHN FINN'S Air Separated Zinc Dust for Cyaniding.

JOHN FINN'S Crank Pin and Empire Anti-Friction Babbitt Metals, universally used in the Mining and Cement Industry. Also manufacturers of all grades of Solder and Type Metals.

Write or wire for prices on your requirements.

John Finn Metal Works

372-398 Second Street, San Francisco, California.

PACIFIC NEW AND RE-NEWED PIPE SAVES MONEY

Renewed screw casing costs one-half to two-thirds less than standard pipe. Large savings on standard pipe, fittings and valves; special fittings made to order. Pacific Pipe is thoroughly tested and guaranteed for 150 pounds working pressure; asphaltum dipped; serves every purpose. Let us save you money. Write!

PACIFIC PIPE CO., 233 HOWARD ST. SAN FRANCISCO

PRECISION

BALANCES AND WEIGHTS
For twenty years metallurgists and assayers have looked upon Thompson Balances and Weights as the acme of precision. Made in a style and size for every purpose.

Write for catalog

THE THOMPSON BALANCE CO.
Denver, Colo.



SILVER PLATED COPPER AMALGAM PLATES

FOR SAVING GOLD

Most extensive and successful manufacturers.
Old plates replated—made equal to new.

SAN FRANCISCO PLATING WORKS

1349-51 Mission St., San Francisco E. G. DENNISTON, Prop.
Get our prices. Catalog sent. Telephone Market 2615.



PRACTICAL ECONOMY

Guaranteed Rebuilt Machinery AT LOW PRICES

Immediate Delivery on Following,
Subject to Prior Sale:

BOILERS:	0 to 250 H.P.
BLOWERS:	1 Connerville, 12 cu. ft. per rev. \$150.00 2 Bakers No. 4 Rotary, each. 200.00
COMPRESSORS:	1 Ingersoll-Rand Straight Line Air Compressor, 16x24 300.00
CRUSHERS:	1 Gates Gyratory No. 1 300.00 1 Blake, 10x4 300.00
ENGINES, STEAM:	1—7½ H.P. 3x5 Vertical 90.00 1—20 H.P. 5x8 Vertical 125.00 1—40 H.P. Brownell, 10x12 300.00 1—40 H.P. Bay State, 10x12 250.00 1—60 H.P. Fraser & Chalmers, 12x18 400.00 1—75 H.P. Corliss 1000.00 1—150 H.P. Corliss non condensing, 16x30 1800.00
GAS EXHAUSTER:	1 No. 3 Roots Gas Exhauster 350.00
GENERATORS:	1—35 KW. Direct Current Generator, Volts no load 116, full load 120, Amps. 292 with Skinner Engine. 1000.00
HANGERS:	All sizes and styles at 50% cost of new.
HOISTS:	1—8x10 Jackson Geared Hoist, Steam. 850.00
HEATERS:	2 Kewanee Heaters, 24"x64", each. 100.00 1 No. 1-R Webster Vacuum Feed Water Heater and Purifier 125.00
MILLS:	1—3¼"x4" Ball Mill 350.00 1—3¼" Huntington Allis-Chalmers 250.00
PIPE:	¾" to 6"
PULLEYS:	Second Hand, Iron and Wood at 50% cost of new
PUNCHES:	1 No. 18 Niagara Punch, capacity ½" 50.00
PUMPS:	1—2½"x2½"x3¼" American Steam Pump 60.00 1—3x2x4 Fairbanks-Morse Boiler Feed Pump 60.00 2—6x4x8 Fairbanks-Morse, each 80.00 1—No. 8 Dourte Valveless 450 G.P.M. 600.00 2—10x8x12 Platt Iron Wks. Duplex, each 250.00 1—12x8x12 Platt Iron Wks. Center Packed 500.00 1—16x26x16x24 Platt Iron Wks., Duplex Compound 2500.00
ROASTERS:	1—5'x24" Shell Roaster complete with trunnions 1200.00
ROLLS:	1 Set 12x20 Davis Rolls 500.00
VALVES:	¾" to 12" at 50% cost of new.

The Rebuilt Machinery Company

COLORADO SPRINGS, COLO.

SULLIVAN DRILLING SERVICE

Established 1884

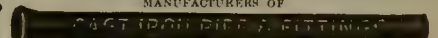
If you want core drilling done, why not employ the "oldest and largest" drilling firm, noted for its accuracy and reliability?
Prices not the highest. Booklet 13,113

Contract Drilling Department

SULLIVAN MACHINERY COMPANY
580 Market St., San Francisco

AMERICAN CAST IRON PIPE COMPANY

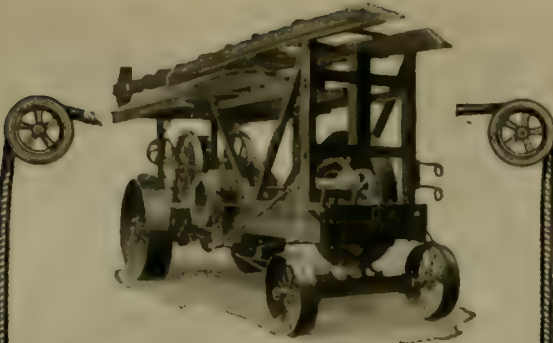
MANUFACTURERS OF



BIRMINGHAM, ALA.

SALES OFFICES:

Birmingham, Ala.—Box 908.
Columbus, Ohio—607 New Hayden Bldg.
Minneapolis, Minn.—712 Plymouth Bldg.
New York City—No. 1 Broadway
Los Angeles, Cal.—339 Citizens' National Bank Bldg.
Chicago, Ill.—512 1st Nat. Bk. Bldg.
Dallas, Tex.—1217 Prudential Bldg.
Kansas City, Mo.—716 Scarratt Bldg.
San Francisco, Cal.—711 Balboa Bldg.



ARMSTRONG CHURN DRILLS TRACTOR AND PORTABLE TYPES

Especially adapted for prospecting Mineral Lands, Oil Lease, and for cleaning out oil wells at low cost.

SPECIAL MODEL FOR BLAST HOLE DRILLING

All types can be furnished with gas engine, steam or electric power.

Catalog and quotations on request

H. C. KAUFMAN & COMPANY

WESTERN DISTRIBUTORS

327 W. 2nd St., LOS ANGELES, CAL.

Armstrong
MACHINE TOOL ELECTRIC
SINCE 1857

A SMITH HYDRAULIC TURBINE



installed in a concrete scroll case, fulfills the requirements of

ABSOLUTE DEPENDABILITY

in the power and pumping equipment furnished the

U. S. RECLAMATION SERVICE
For SUNNYSIDE, WASH., Plant
as shown in accompanying illustration

TURBINE DEVELOPS
214 H. P., 225 R. P. M.
UNDER 21 FEET HEAD

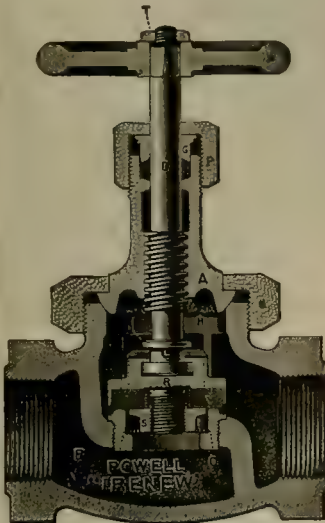
All parts easily accessible for inspection and removal, due to action of silt at certain seasons.

Similar unit now being built for Grand Valley Project in Colorado
WRITE DEPT. "V" FOR BULLETIN

S. MORGAN SMITH CO., YORK, PA.

CHICAGO 76 W. Monroe St. BOSTON 176 Federal St. MONTREAL 405 Power Bldg. SAN FRANCISCO 461 Market St.

POWELL "IRENEW" VALVE WITH UNION COMPOSITE DISC Iron Body, Bronze Mounted



Made in Sizes $\frac{1}{4}$ to 2" Inclusive

Screw and Flange Ends

All Parts Interchangeable

Good for 150 Pounds Steam Working Pressure

The only Rubber Disc in an iron body valve in such small sizes to stand up to their specifications.

Write for
Quotations
Today

THE WM POWELL CO.
DEPENDABLE ENGINEERING SPECIALTIES
CINCINNATI, O.

Send for Special Illustrated Catalogue

American Steel & Wire Company

CHICAGO NEW YORK CLEVELAND PITTSBURGH DENVER

'TIMBER FRAMING'

By H. D. DEWELL, C. E.

275 PAGES, FULLY ILLUSTRATED. PRICE POSTPAID, \$2.50

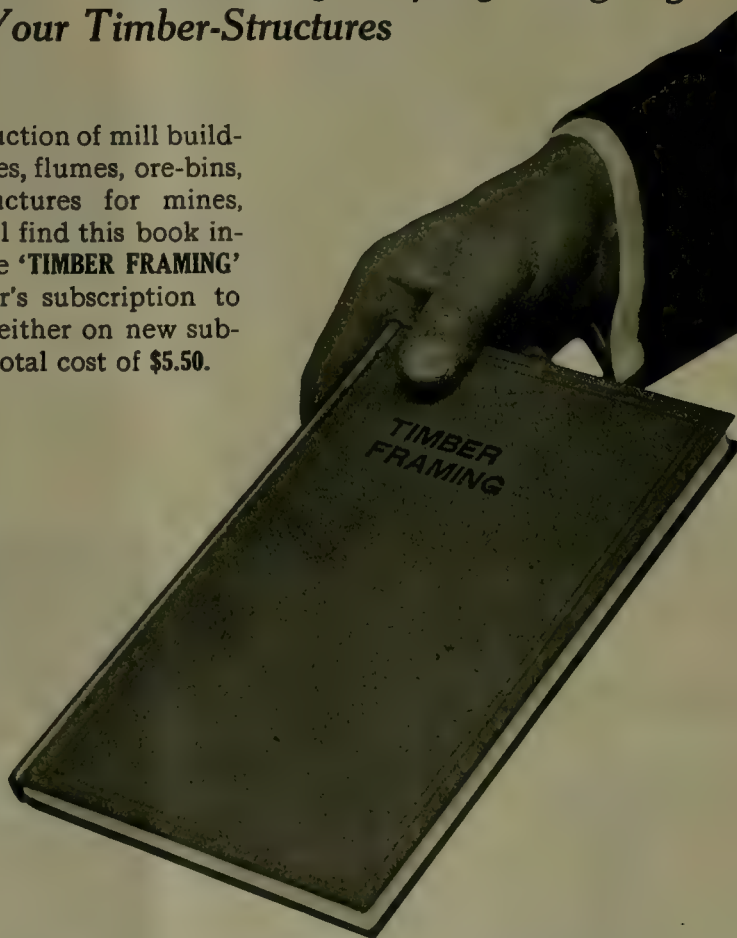
SECOND IMPRINT

Eliminate the Waste of Materials by Properly Designing Your Timber-Structures

IN the economical construction of mill buildings, head-frames, trestles, flumes, ore-bins, tanks, and other structures for mines, the mining engineer will find this book indispensable. You can secure 'TIMBER FRAMING' in combination with a year's subscription to MINING AND SCIENTIFIC PRESS, either on new subscriptions, or renewals, at a total cost of \$5.50.

THIS BOOK CONTAINS

Design and Construction of Head-frames, Flumes, Ore-bins, Trestles, Water Towers, and Mill Buildings. Rules for Grading Lumber. Unit Stresses of Tension. Compression, Shear and Bending, Co-ordination of Tests. Truss Detail and End Connections. Nailed, Screwed, and Bolted Joints. Intermediate Joints and Tension Splices. Foundation, Columns, and Connections. Specifications for Timber Framing.



SPECIAL OFFER COUPON

MINING AND SCIENTIFIC PRESS, 420 Market St., San Francisco

P 5

..... ENTER my subscription to MINING AND SCIENTIFIC PRESS beginning with the current issue.
 RENEW my subscription to MINING AND SCIENTIFIC PRESS at the expiration of my present subscription. Also send the new book "Timber Framing," by H. D. Dewell. For this I enclose \$5.50, to be divided as follows: \$4 for the MINING AND SCIENTIFIC PRESS (U. S. and Mexico), and \$1.50 for the book (price \$2.50 if sold separately); Canada, \$5 and \$1.50 for the book; other countries in postal union, \$6 and \$1.50 for the book.

Name Vocation

Address Employed by 1-3-20



LAMP BREAKAGE AND THEFT INCREASE THE COST OF PRODUCTION

Protect your lamps from breakage
or unauthorized removal by using

FLEXCO-LOK

Expanded Steel Lamp Guards

Flexco-Lok Lamp Guards effectively protect the lamp against any sudden shock to which it may be subjected.

Flexco-Lok is very simple in construction and is easily adjusted. It is LOCKED with a key which prevents theft.

A single broken or stolen lamp costs more than a guard. Install Flexco-Lok Lamp Guards now.



Flexible Steel Lacing Co.,

Manufacturers of "ALLIGATOR" Steel Belt Lacing
Dept. LG26

522 So. Clinton Street

Chicago, Ill.

Rotary Air Compressors

Save 50% Floor Space and Weight



Type 180 A.
Capacity 180 Cu. Ft. Weight.
2580 Lbs. Price \$875.00.

Equipped with Intake and Discharge Unloaders.

Cheaper Air and No Trouble

Light weight and no vibration means no expensive foundations. Easy to install. The rotary motion (well balanced torque) means high driving efficiency and low operating cost. We can prove that Jackson Rotary Compressors deliver cheaper air, continuous service and no trouble. Write for bulletin No. 3.

THE JACKSON COMPRESSOR CO.

233 South Cherokee St., Denver, Colorado

Built along entirely new lines. Rotary—not turbine design—but as distinctly a positive displacement compressor as the piston type.

Only five moving parts, always running in oil. All bearings Hyatt Roller—"high duty".



GIANT

Our service men will co-operate

There is a Giant Service Man near you who will gladly help you solve your blasting problems. If need be, he will go right to your field of operation without charge or obligation. Your explosives will do more and better work for less money when you take advantage of Giant Service facilities.

Write us in detail regarding the conditions of your blasting. Our response will be prompt, helpful and efficient.

THE GIANT POWDER CO., Con.
"Everything for Blasting"
Home Office: San Francisco
Branch Offices: Denver, Portland, Salt Lake City, Seattle, Spokane

EXPLOSIVES

It's A "LITTLE GIANT" IN STRENGTH



YET---
LIGHT IN WEIGHT
BECAUSE IT'S
SEAMLESS ALUMINUM

THIS AND OVER
40 OTHER STYLES
...OF...

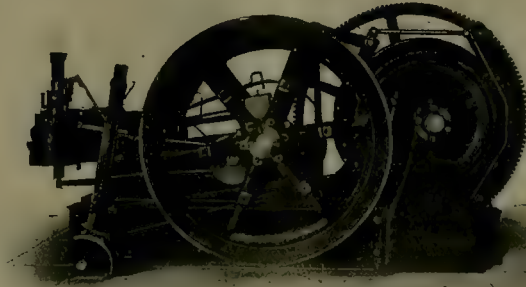
**MINER'S
CARBIDE
LAMPS**

MADE BY
JUSTRITE MANUFACTURING CO.
2075 SOUTHPORT AVE., DEPT M, CHICAGO, U. S. A.

No.
110

6 Hours
Capacity

1919
Catalog
On
Request



"WESTERN" Hoisting and Power Equipment

"Western" Engines and "Western" Hoisting Engines, representing the highest types of power and hoisting equipments built, today are operating in some of the largest properties in the world.

The service they are giving, under most severe conditions in some instances, is their best recommendation.

Let us place such information before you for your guidance in selecting the most efficient, economical and dependable equipment for your properties. Simply write for complete data, stating size and type of equipment required.

Western Machinery Company

910 NORTH MAIN STREET, LOS ANGELES, CALIF.

Branch: Rialto Bldg., San Francisco, Calif.

GARRATT JACK HEAD PLUNGER PUMPS

**Are Not Affected by
Muddy, Gritty Water**

The cylinder has large clearance and the plunger is outside packed at the top. The suction and discharge valves are fitted with bronze taper seats and are easily exchanged by removing bonnets. The Jack Head works altogether on the down stroke; the pump rod is made to weigh just half the amount of pressure exerted on the plunger so that the load is equal and uniform at all times whether on down or up stroke. In this way

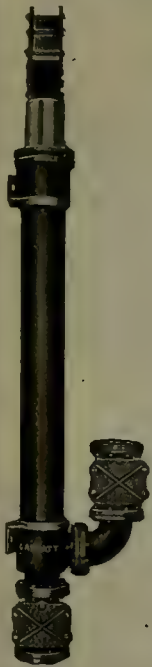
Balance Bob is Eliminated

thereby increasing the efficiency and materially reducing cost of installation. These pumps are made with capacities of from 30 to 500 gallons per minute and for elevations up to 600 feet.

W. T. GARRATT & CO.

Established 1850

299 Fremont St. San Francisco, Cal.



GRIND—don't CUT

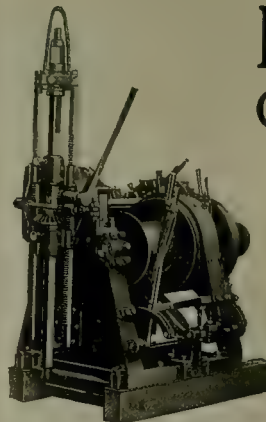
You can grind rock or placer-ground faster than you can cut it; therefore, we use a shot-bit giving a grinding edge that fairly eats through the ground.

DOBBINS CORE DRILL

"KNOW THE TRUTH" about your property. It's easy. The Dobbins brings up clean cores fifteen and twenty feet long—and does it uniformly.

The Dobbins is in use the world over on every kind of rock or placer-ground. You can learn all about the Dobbins from one of our agents or

Write directly to us for booklet 16, mentioning the character of your ground.



DOBBINS CORE DRILL CO., Inc.

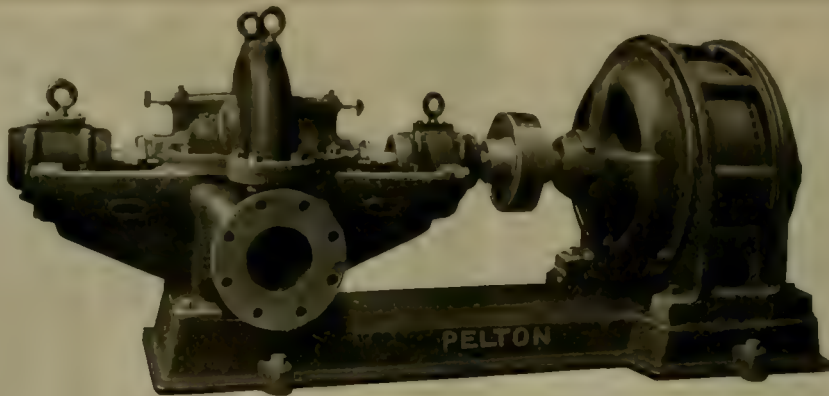
147 WEST 42nd STREET

NEW YORK CITY

AGENTS:

HARRON, RICKARD & McCONE,
SALT LAKE HARDWARE COMPANY,

San Francisco and Los Angeles
Salt Lake City, Utah

P
E
L
T
O
NP
E
L
T
O
N

The increasing tendency among machinery manufacturers, to offset higher first cost, is to design equipment that will give longer and more efficient service in operation. This idea has been carried out in the design of *Pelton* Type DS double suction pumps—high efficiency single-stage units.

Type DS pumps are for use under medium heads and volumes, for any type of prime mover drive. They are double suction, single stage, split case units, constructed with the very best of materials and workmanship, and guaranteed for sustained high efficiency in operation.

We will be very glad to give specific details on Type DS pumps for particular pump installations. Bulletin No. 10 gives general information on their design, construction and application. May we send you a copy?

THE PELTON WATER WHEEL COMPANY

1986 Harrison Street, San Francisco, Cal.

86 West Street, New York, N. Y.

The Rotary Car-Dumper

SAVES labor, by using only one man at the shaft bottom.

INCREASES hoisting capacity by 25 to 30%.

Dumps cars clean.

Cut costs in half by using solid-body cars.

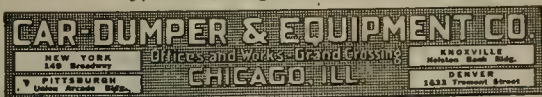
Maintenance expense almost eliminated.



Mine is kept clean, the cars being ore and water-tight, avoiding leakage along the drift.

We make installations in both old and new mines.

We offer you improvements and protection under the Ramsay, Wood, Claghorn and other patents.



(Formerly Wood Equipment Co.)

(46)

THE APPLICATION of ELECTROLYSIS in CHEMICAL INDUSTRY

By A. J. HALE

Cloth

\$2.65

148 pp.

A ready reference containing the following chapter headings: Introduction; Methods of Generating the Current; The Electrolytic Refining of Metals; The Electrolytic Winning of Metals; Electrolytic Production of Hydrogen and Oxygen; Electrolysis of Alkali Chlorides; Chlorine and Caustic Soda; Electrolysis of Alkali Chlorides; Hypochlorites, Chlorates, Perchlorates; Production of Inorganic Compounds; Production of Organic Compounds.

USE THE COUPON

MINING AND SCIENTIFIC PRESS,
420 Market Street, San Francisco, Cal.

Gentlemen: Enclosed find \$2.65 for which send me one copy of Hale's Application of Electrolysis in Chemical Industry.

Name

Address

LG-13-20

"The Economic Geology of South American Deposits"
Mineral Deposits of South America

By MILLER and SINGEWALD

598 pp.

\$5.00

Cloth

**MINERAL
DEPOSITS
OF
SOUTH
AMERICA
—
MILLER
AND
SINGEWALD**

CONTENTS:

- 1—ECONOMIC GEOLOGY OF SOUTH AMERICA
- 2—ARGENTINA
- 3—BOLIVIA
- 4—BRAZIL
- 5—CHILE
- 6—COLOMBIA
- 7—ECUADOR
- 8—GUIANA
- 9—PARAGUAY
- 10—PERU
- 11—URUGUAY
- 12—VENEZUELA

Also contains a number of valuable illustrations and maps.

At the end of each chapter is a bibliography of selected articles for further research.

MINING AND SCIENTIFIC PRESS,
 420 Market Street, San Francisco

Gentlemen: Enclosed find \$5 for which send me one copy of Miller and Singewald 'Mineral Deposits of South America'.

Name

Address

It is understood if the above book proves unsatisfactory, I am at liberty to return it within ten days and refund will be made of the purchase price.

Mc 1-3-20

**The ELSOL
 DRY* CONCENTRATOR**



Handles all Dry Ores Successfully

For working all kinds of Concentrating Ores in Quartz or Placer. Saves the fines as well as the coarse. No dust. Utmost simplicity.

Write for Catalog B

YOUNG & TYLER, 428 Wesley Roberts Bldg., Los Angeles, Cal.

WELLMAN-LEWIS COMPANY

**Mechanical and Metallurgical
 ENGINEERS**

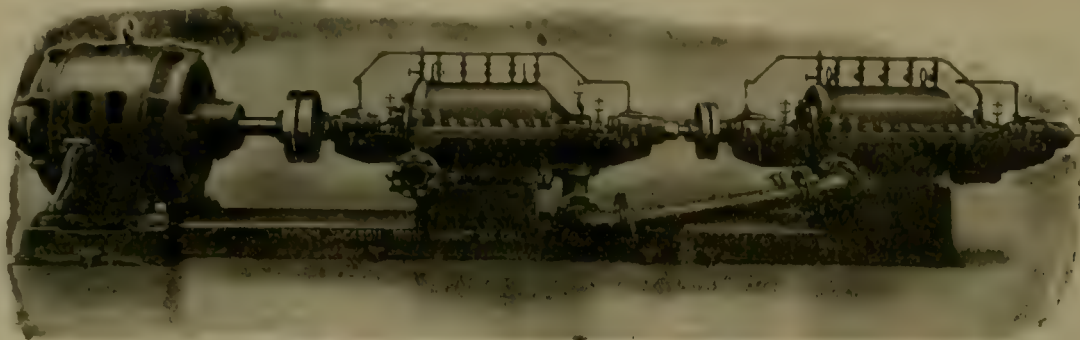
**MILLS DESIGNED AND CONSTRUCTED
 CONSULTING AND EXPERT WORK
 TESTS CONDUCTED**

Specializing flotation of Complex and Carbonate ores.
 Cyanide treatment of Silver and Gold ores.

If you are contemplating building a mill, let us figure with you upon designing and construction. We have the organization and equipment and can construct your mill quicker than you can, and at less cost.

If your mill is not making a satisfactory recovery of the values, let us investigate and place you upon a paying basis. We have a full staff of competent Metallurgical and Mechanical Engineers.

**900 Hibernian Building
 Los Angeles California**



The BYRON JACKSON MINE STATION PUMP

is a self-contained unit, consisting of a twin six-stage, Centrifugal, Direct Connected Pump

It is fitted with flexible couplings and water-cooled, marine type thrust bearings.

We have shipped several pumps of this type during the past few months. Examples of capacities and heads are as follows:

225 G.P.M.	840' head	1750 R.P.M.
250 "	1020' "	1750 "
550 "	840' "	1750 "
450 "	1560' "	2300 "

We build these pumps for heads up to 2000'

Submit your pumping problems to us. No obligation. Write today for Catalogue No. 71

Byron Jackson Iron Works

Sharon Building
San Francisco

Callow Traveling Belt Screen

(For Wet Screening)

The
Screen
Supreme

for
Economy,
Simplicity,
Efficiency

The Callow Screen, used in closed circuit with your crushing mill,

will screen out all particles crushed to proper size. Those too coarse for the treatment machines are sent back to the mill to be crushed again, while those particles already fine enough are not returned, as with many other devices.

The Callow Traveling Belt Screen is among the most efficient and practical screening machines on the market. Running cost is small; operation is simple; a maximum capacity run is assured.

GUARANTEES an evenly crushed product; cleaner millings; lower tailings. Send coupon for Bulletin 700.



Galigher
Machinery Co.,
Salt Lake City.

Send us Bulletin
No. 700.

Name

Address

THE GALIGHER MACHINERY CO

101 WEST 2ND SOUTH (DOOLY BLOCK)

SALT LAKE CITY

Because of its strength
toughness and flexibility,
it is safe and durable

Because of its
durability it is
economical

HERCULES (RED STRAND) WIRE ROPE

Made by
A. Leschen & Sons
Rope Company

St. Louis, Mo.
New York Chicago Denver
Salt Lake City San Francisco

NATIONAL QUALITY TANKS

There are three distinct reasons why "National Quality" Tanks give the best of service:

First, they are made from either Douglas Fir or California Redwood, the two best known woods for tank purposes.

Second, they are securely bound with the best steel hoops which always hold the tank in shape.

Third, by careful and painstaking workmanship the staves and bottoms are fitted together accurately and perfectly.

All sizes and styles of National Tanks are furnished by us. You can get tanks for any purpose made to suit your needs. The U. S. government has used many carloads. Big mines use them everywhere. Careful attention given to special installations.

Tell us your needs and get our prices

NATIONAL TANK & PIPE CO. 275 OAK ST. PORTLAND, ORE.



THE LANE MILL
has no superior as an
amalgamator. In numer-
ous competitive tests it has
demonstrated its superi-
ority in this line of work.
Send for our Catalog No. 9
and learn all about it.

**LANE MILL AND
MACHINERY CO.**
106 W. Third St.
Los Angeles, Calif.

DEWEY, STRONG & TOWNSEND PATENT ATTORNEYS

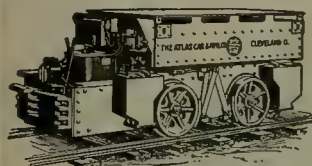
U. S. and Foreign Patents
Preliminary Searches
Validity Reports

Infringements
Trademarks
Copyrights

910-918 CROCKER BLDG., SAN FRANCISCO

— PINE — FLOTATION OILS

Pensacola Tar & Turpentine Company
F. E. MARINER, PRES. GULL POINT, FLA.



LOCOMOTIVES AND CARS

FOR MINES, SMELTERS, ETC.
ELECTRIC CARS

Switches, Frogs, and Equipment

THE ATLAS CAR & MFG. CO.
Dept. K, CLEVELAND, OHIO



THE MARATHON MILL (Trunnion Type)

The Marathon Mill has repeatedly demonstrated its superiority over ball, chilian, pebble, and other types of mills in official tests conducted by independent engineers for some of America's most representative mining companies. Repeat orders have attested to the Marathons decided superiority.

Write for complete reports of competitive tests showing from 2 to 4 times as much capacity per horsepower and details regarding construction and operation.

MARATHON MILL & MACHINERY WORKS
FIRST NATIONAL BANK BUILDING, CHICAGO, U. S. A.

FOREIGN AGENTS:

REUNERT & LENZ, Ltd., Johannesburg, S. A.
L. J. HEALING & CO., Tokio, Japan

SACRAMENTO PIPE WORKS

MANUFACTURERS

**SHEET STEEL RIVETED PIPE,
WELL CASING and AIR PIPE**

WHOLESALE DISTRIBUTERS

Standard Pipe—Screw Joint Casing, Pipe
and Casing Fittings,

HYDRAULIC ENGINEERS AND CONTRACTORS

Valves and Brass Goods

SACRAMENTO, CAL.

LUFKIN

Backed by a record of 25 years
of dependable service

CATALOG ON REQUEST

THE LUFKIN RULE CO.

Measuring
Tapes and
Rules

SAGINAW, MICH.
New York



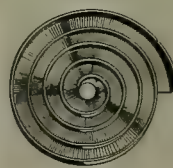
**FARREL / BACON
ORE & ROCK
CRUSHERS / ROLLS**
EARLE C. BACON, INC., ENGINEERS.
26 CORTLANDT ST., NEW YORK. SEND FOR BULLETIN C-1

FLOTATION

PURE PINE OIL PINE TAR OIL
HARDWOOD AND COAL TAR CREOSOTE

Write for new Booklet

General Naval Stores Co., 90 West Street, New York



FRENIER'S SAND PUMP

THE MOST DURABLE FOR

SLIMES, TAILINGS, BATTERY SANDS, Etc.

AGENTS

Allis-Chalmers Co. Stearns-Roger Mfg. Co.
Milwaukee, Wis. Denver Colo.
Harron, Rickard & McCone, San Francisco
Frank E. Perrot, Sydney and Perth, Australia
FRENIER & SON, RUTLAND, VT.

"NEW CLEVELAND" POCKET-IN-HEAD STOPERS

Made in two sizes to meet every stopping requirement.

The 2S stoper weighs 75 pounds with a piston diameter of two inches and is recommended for every class of work except the **very hardest rock**.

The 4S stoper weighs 100 pounds with a piston diameter of two and a half inches and is adapted to the drilling of the very hardest of rock.

From 20 to 30% Greater Footage

with the Cleveland Stoper is quite common performance, and yet the power consumption is decidedly lower.

Cleveland "Pocket-in-Head" Stopers are made of a class of steel and forgings not ordinarily used in rock drill parts. Repair costs are decidedly lower than usual.

Try One and Be Convinced.

CLECO valves and nipples, "Neverlip" hose clamps, hose menders, "Neverleak" couplings and "Veribest" air hose are all noted for long and satisfactory service. Send us a trial order.

2S "NEW
CLEVELAND"
POCKET-IN-HEAD
STOPER

THE CLEVELAND ROCK DRILL CO.

3734 East 78th St.,

CLEVELAND, OHIO

4S "NEW
CLEVELAND"
POCKET-IN-HEAD
STOPER

CEMENT-GUN
TRADE MARK



They speak of a "Cement-Gun" as they would of a drill—

The day is past when the "Cement-Gun" was thought of as one of a number of similar devices. Now, mining engineers say, "use the 'Cement-Gun,'" just as they would say, "use an air-drill."

For there is only one "Cement-Gun." It is used the world over for lining shafts, fireproofing woodwork, preventing the weathering of rock, constructing fire bulkheads, lining reservoirs or flumes, and a thousand other purposes.

If you are one of the few who has not yet become familiar with the "Cement-Gun" it will pay you to investigate.

Detailed information on the uses for a "Cement-Gun" in mining work will be sent upon request and without obligation.

CEMENT-GUN COMPANY, Inc.

Allentown, Penn.

30 Church St., New York City
1414 Fisher Bldg., Chicago, Ill.
211 Fulton Bldg., Pittsburgh, Pa.
Citizens Nat. Bank Bldg., Los Angeles

612 Mohawk Block, Spokane, Wash.
812 Va. Ry. & Power Bldg., Richmond, Va.
General Supply Co., Ltd., Winnipeg, Man.

Agencies in all Principal Foreign Countries

Traylor Portable Steam or
Electrically Driven Air
Compressors for Mine and
Contractor.

Dewey Combined Air Dryer
and Water Heaters deliver
DRY AIR to your "Gun
or Air Tools."

Traylor Combined Mixer
and Elevator for thor-
oughly mixing sand and
cement for use in the
Cement-Gun makes better
"Gunite."

PROFESSIONAL DIRECTORY

RATES: One-half inch, \$25 per year, subscription included. Combination rate with The Mining Magazine (London) one-half inch in each, \$40 per year, subscription included

ABRAHAMSON, Hjalmar
PETROLEUM GEOLOGIST AND ENGINEER
Specialty, Texas Geology and Appraisals
502 Texas State Bank Bdg., Fort Worth, Tex.

ADDICKS, Lawrence
CONSULTING ENGINEER
6 Church St., New York City
Cable: Galie, New York

AGUILAR-REVOREDO, J. F.
CONSULTING MINING ENGINEER
Examination, valuation and development of
mines in Bolivia
Casilla 178, Oruro, Bolivia

ALDRIDGE, Walter H.
MINING AND METALLURGICAL ENGINEER
50 East 42nd St., New York

ANDERSON ENG. CO., G. E.
GEOLOGISTS
Petroleum and Metals
417 Burton Bdg., Forth Worth, Texas

ARGALL & SONS, Philip
MINING AND METALLURGICAL
ENGINEERS
First National Bank Bdg., Denver
Cable: Argall Code: Bedford McNeill

ARNOLD, Ralph
GEOLOGIST AND PETROLEUM ENGINEER
Union Oil Bdg., Los Angeles, Cal.
120 Broadway, New York
Cable: Ralfarnoll Code: Bedford McNeill

B. C. Austin W. V. Wilson
AUSTIN & WILSON
MINING ENGINEERS
805 Santa Marina Bdg., San Francisco, Cal.
Cable: Austin Usual Codes

BALL, Sydney H.
MINING GEOLOGIST
42 Broadway, New York
Cable: Alhasters Rogers, Mayer & Ball

BANCROFT, Howland
CONSULTING MINING GEOLOGIST
Symes Bdg., Denver
Casilla No. 215, Oruro, Bolivia
Cable: Howban Code: Bedford McNeill

BARKER, Edgar E.
MINING ENGINEER
Morococha, Peru

BARLING, H. B.
MINING ENGINEER
11 Pine St., New York. Marquette, Mich.
Code: McNeill

BEAM, A. Mills
METALLURGICAL AND CONSULTING
ENGINEER
807 Central Savings Bank Bdg.,
Denver, Colorado

BEATTY, A. Chester
CONSULTING MINING ENGINEER
25 Broad St., New York
No professional work entertained
Cable: Granitic

Hamilton, Beauchamp, Woodworth, Inc.
BEAUCHAMP, F. A.
METALLURGIST
Specialty: Flotation
419 Embarcadero, San Francisco

BELL, J. Macintosh
MINING ENGINEER AND GEOLOGIST
Office with Messrs. Bain, Bicknell & Co. Lums-
den Bdg., Toronto, Can. London Address %
Bk. of New Zealand, 1, Queen Victoria St., E.C.

BELLINGER, H. C.
METALLURGICAL ENGINEER
% Chile Exploration Co., Chuquicamata
(via Antofagasta) Chile, South America

BENEDICT, William de L.
MINING ENGINEER
19 Cedar St., New York

BLAISDELL CO., THE
H. W. Blaisdell, President
Specialty: Designing and Constructing Exca-
vators for Circular and Rectangular Vats
480 Pacific Electric Bdg., Los Angeles, Cal.

BOISE, Charles W.
MINING ENGINEER
Foreign Exploration
Cable: Mukeba 42 Broadway, New York

BOSQUI, Francis L.
METALLURGICAL ENGINEER
90 West St., 54 New Broad St.,
New York London, E.C.

BRAYTON, Corey C.
MINING ENGINEER
2937 Magnolia Ave., Berkeley, Cal.

BRODIE, Walter M.
MINING ENGINEER AND METALLURGIST
47 Cedar St., New York

BROWN, R. Gilman
CONSULTING ENGINEER
Pinner's Hall, London, E.C. 2
Cable: Argeby Usual Codes

Burch, Hershey & White
BURCH, Albert
CONSULTING ENGINEER
Crocker Bdg., San Francisco
Cable: Burch Usual Codes

BURCH, H. Kenyon
CONSULTING ENGINEER
Phelps Dodge Corporation,
Copper Queen Branch
Bisbee, Arizona

BURGER, C. C.
MINING ENGINEER
71 Broadway, New York

CARPENTER, Alvin B.
MINING ENGINEER
Citizens National Bank Bdg., Los Angeles

CARR, Homer L.
MINING ENGINEER
50 Broad Street, New York

CHANCE & CO., H. M.
COAL MINING ENGINEERS IRON
839 Drexel Bdg., Philadelphia

CHANNING, J. Parke
CONSULTING ENGINEER
61 Broadway, New York

CHASE, Charles A.
MINING ENGINEER
825-826 Cooper Bdg., Denver
Liberty Bell G. M. Co., Telluride, Colo.

Edwin E. Chase R. L. Chase
CHASE & SON, Edwin E.
MINING ENGINEERS
1028 First National Bank Bdg., Denver

COHEN, Samuel W.
CONSULTING MINING ENGINEER
Dominion Express Bdg., Montreal, Canada

COLE, F. L.
MINING ENGINEER
American Trading Co.,
25 Broad St., New York

COLLBRAN, Arthur H.
MINING ENGINEER
Seoul, Korea

COLLINS, Edwin James
MINING ENGINEER
Mine Examinations and Management
1008-1069 Torrey Bdg., Duluth, Minn.

COLLINS, George E.
MINING ENGINEER
Mine Examinations and Management
414 Boston Bdg., Denver
Cable: Colcomac

COLLINS, Henry F.
MINING AND METALLURGICAL ENGINEER
66 Finsbury Pavement, London, E.C.

PROFESSIONAL DIRECTORY

COLLINS, W. F.
CONSULTING MINING & METALLURGICAL
ENGINEER
Cable: Collins, Peking Peking, China

CRANSTON, Robert E.
MINING ENGINEER
1213 Hobart Bldg., 382 Market St.
San Francisco 2 Reclor St., New York
Cable: Recrana Code: McNeill 1908

DARLING, Harry W.
Field Engineer for Crown Reserve M. Co., Ltd.
30 North Chapel St., Alhambra, Cal.

DAVIS, Leverett
MINING ENGINEER
Examination, Development, Management
911 Foster Bldg., Denver, Colo.

DEFTY, W. E.
MINING ENGINEER
618 North Third Avenue
Phoenix, Arizona

DE KALB, Courtenay
MINING ENGINEER
Temporarily engaged on investigation of
Spanish Mineral Resources for U. S. Dept. of
Commerce, Washington, D. C.

DEL MAR, Algernon
MINING ENGINEER AND METALLURGIST
Specialty: Mill Operation and Construction
1424 Alpha St., Los Angeles

DENNIS, Clifford G.
MINING ENGINEER
Crocker Bldg., San Francisco
Cable: Sinned Code: McNeill

DICKERMAN, Nelson
MINING ENGINEER
The Insurance Exchange, San Francisco
Cable: Deerhodor Code: McNeill 1908

DOLBEAR, Samuel H.
CONSULTING MINING ENGINEER
1415 Merchants National Bank Bldg.,
San Francisco

DORR COMPANY, THE
John V. N. Dorr, President
HYDROMETALLURGICAL AND WET CHEM-
ICAL ENGINEERS
Denver New York London, E.C.

DUDLEY, H. C.
MINING ENGINEER
704 Lonsdale Bldg., Duluth, Minn.

Lindsay Duncan Curtis Lindley, Jr.
DUNCAN & LINDLEY
MECHANICAL ENGINEERS FOR MINES
AND MILLS
649 Mills Bldg., San Francisco

DWIGHT, Arthur S.
MINING ENGINEER AND METALLURGIST
29 Broadway, New York
Cable: Sinterer Code: McNeill; Miners & Smelters

DYER, S. C.
MINING ENGINEER
Box 19, Bulawayo, Rhodesia
Telegrams: Minerals Usual Codes

EASTON, Stanley A.
MINING ENGINEER
Manager Bunker Hill & Sullivan Mining &
Concentrating Co., Kellogg, Idaho

ELFTMAN, A. H.
MINING GEOLOGIST AND ENGINEER
1209 Hobart Bldg. 400 State Bank Bldg.
San Francisco, Cal. Tonopah, Nevada

H. W. Evans J. C. Ballagh
EVANS & BALLAGH
MINING AND METALLURGICAL ENGINEERS
P. O. Box 1155, El Paso, Texas

EYE, Clyde M.
MINING AND METALLURGICAL ENGINEER
5c Wells Fargo Nevada Nat. Bank,
San Francisco, Cal.
Cable: Eyecon Codes: Western Union

FARISH, George E.
CONSULTING MINING ENGINEER
First National Bank Bldg., San Francisco
25 Broad St., New York

FARISH, John B.
MINING ENGINEER
Office, 58 Sutter St., San Francisco
Residence, San Mateo, Cal.
Cable: Farish

Rowland King Chas. Mailhot
FASSETT COMPANY, Inc., The C. M.
MINING & METALLURGICAL ENGINEERS
ASSAYERS & CHEMISTS
209 Wall St., Spokane, Wash.

FEAGLES, R. L.
MECHANICAL AND METALLURGICAL
ENGINEER
Deister Machine Company
Fort Wayne, Ind.

FINLAY, J. R.
MINING ENGINEER
Room 807, 45 Cedar St., New York

FISHER & LOWRIE
CONSULTING GEOL. AND FUEL ENGRS.
1st Nat. Bk. Bldg., Denver, 423 Broad St., New
York, 826 Great Southern Bldg., Dallas, Tex.
Cable: Calishoil Usual Codes

FITCH, Walter Jr.
SHAFT AND TUNNEL CONTRACTING
AND
CONSULTING ENGINEER
Mount Carmel, Pennsylvania Eureka, Utah

FOWLER, Samuel S.
MINING ENGINEER AND METALLURGIST
Nelson, British Columbia
Cable: Fowler Usual Codes

FREITAG & AINSWORTH
DESIGNING AND CONSTRUCTING ENGRS.
Mine and Metallurgical Plant Design and
Construction
1209 Hobart Bldg., San Francisco

GABY, W. E.
MINING GEOLOGIST
Phoenix, Arizona

GAHL, Rudolf
CONSULTING METALLURGIST
804 Equitable Bldg., Denver, Colo.

GARREY, George H.
CONSULTING MINING GEOLOGIST AND
ENGINEER
Rulitt Bldg., Philadelphia, Pa.

GEPPERT, Richard M.
MINING ENGINEER
69 Berwyn St., Orange, New Jersey, U. S. A.

GOSROW, R. C.
ELECTROMETALLURGIST
METALLURGICAL ENGINEER
Specialty: Electric Furnaces
504 Maynard Bldg., Seattle, Wash.

GRANT, Wilbur H.
GEOLOGIC AND MINING ENGINEER
1213 Hobart Bldg., 582 Market St.,
San Francisco
Code: Bedford McNeill

GREENAN, James O.
MINING ENGINEER
Mina, Nevada

S. B. Davis Anton Kragtorp
GREENOUGH, W. Earl
CONSULTING MINING ENGINEER
Old National Bank Bldg., Spokane, Wash.

HAMILTON, E. M.
METALLURGIST
Specialty: Cyaniding Gold and Silver Ores
419 The Embarcadero, San Francisco

HANSON, Henry
METALLURGICAL ENGINEER
Specialty: Gold and Silver Ores
Plant Design and Construction
Hobart Bldg., San Francisco, Cal.

HAWXHURST, Robert, Jr.
MINING ENGINEER
234 Holbrook Building,
58 Sutter St., San Francisco, Cal.
Cable: Hawxhurst

Burch, Hershey & White
HERSHEY, Oscar H.
CONSULTING MINING GEOLOGIST
Kellogg, Idaho
Cable: Hershey Code: McNeill

HOFFMANN, Karl F.
MINING ENGINEER
% General Development Co.,
Code: McNeill 1908 61 Broadway, New York

HOFFMANN, Ross B.
MINING ENGINEER
228 Perry St., Oakland, Cal.
Cable: Siberhof

HOLLIS, H. L.
CONSULTING MINING ENGINEER
AND METALLURGIST
1025 Peoples Gas Bldg., Chicago

HOOVER, Herbert
MINING ENGINEER
120 Broadway, New York

PROFESSIONAL DIRECTORY

HOOVER, Theodore J.
MINING ENGINEER
1. London Wall Bdg., London, E.C.
and 634 Mills Bdg., San Francisco
Cable: Mildaloo

HOLLOWAY & CO., Geo. T., Ltd.
METALLURGISTS AND METALLURGICAL
ENGINEERS
13 Emmett St., Limehouse, London, E.C.
Cable: Neoithic Code: McNeill

HOSKIN, Arthur J.
CONSULTING ENGINEER
Mining, Metallurgy, Geology, Oil Shale
Technology
401 Kittredge Bldg., Denver, Colo

HOYLE, Charles
MINING ENGINEER
Apartado 8, El Oro, Mexico

HUSTON, H. L.
MINING ENGINEER
811 Alaska Commercial Bdg., San Francisco
Cable: Haruston

HUTCHINS, John Power
CONSULTING MINING ENGINEER
Room 3700, 120 Broadway,
New York

Dudley J. Inskipp John A. Bevan
INSKIPP & BEVAN
MINING ENGINEERS
1 Broad St. Place, London, E.C.
Cable: Monazite Usual Codes

JANIN, Charles
MINING ENGINEER
716 Kohl Bdg., San Francisco
Cable: Charjan Code: McNeill

JENKS, Arthur W.
MINING ENGINEER AND METALLURGIST
2601 Hilleress Ave., Berkeley, Cal

JULIAN, E. A.
MINING ENGINEER
Goldfield Consolidated Mines Exploration Co.
Crocker Bdg., San Francisco, Cal.

KEENE, Amor F.
CONSULTING MINING ENGINEER
233 Broadway, New York
Cable Address: Kamor, New York

E. H. Kennard E. C. Bierce
KENNARD & BIERCE
MINING AND METALLURGICAL ENGRS
Mill Design and Construction, Filtration,
Hollingsworth Bdg., Los Angeles, Cal

E. P. Kennedy L. K. Kennedy
KENNEDY & KENNEDY
MINING ENGINEERS
418 Foxcroft Bdg., San Francisco, Cal.

KINZIE, Robert A.
MINING ENGINEER
First National Bank Bdg., San Francisco

KIRBY, Edmund B.
MINING ENGINEER AND METALLURGIST
913 Security Bdg., St. Louis
Specialty: The expert examination of mines
and metallurgical enterprises

KIRK, Morris P.
MINING ENGINEER
General Manager Yellow Pine Mining Co.,
Goodsprings, Nevada

KRUMB, Henry
MINING ENGINEER
Felt Bdg., Salt Lake City, Utah

LACHMUND, Oscar
MINING ENGINEER AND METALLURGIST
217 Symons Block,
Spokane, Wash.

LAKENAN, C. B.
MINING ENGINEER
Ely, Nevada

LEHMANN, Charles
MINING ENGINEER
Examination and Management of Properties
Casilla 1364, Santiago, Chill, S. A.

LEVENSALE, L. A.
MINING ENGINEER
1511 Grand Ave., Seattle, Wash.

LEWIS, H. Allman
CONSULTING ENGINEER
Cochabamba, Bolivia
The Berenguela Tin Mines, Ltd.,
Turu Ingenio, Potosi Code: McNeill 1908

LLOYD, R. L.
METALLURGICAL ENGINEER
Specialty: Pyro-Metallurgy of Copper and As-
sociated Metals. 29 Broadway, New York
Cable: Ricloy Code: McNeill

Bewick, Moreing & Co.
LORING, E. A.
MINING ENGINEER
62 London Wall, London, E.C., 2
Cable: Ringlo Usual Codes

LORING, Frank C.
MINING ENGINEER
Sun Life Bdg., Toronto, Ontario, Canada

Bewick, Moreing & Co.
LORING, W. J. MINING ENGINEER
62, London Wall, London, and
614 Crocker Bdg., San Francisco, Cal.
Cable: Wantoness Usual Codes

LONGYEAR COMPANY, E. J.
EXPLORING ENGINEERS AND GEOLOGISTS
Diamond Drilling and Shaft Sinking
Contractors
Manufacturers of Diamond Drills and Supplies
General Office: 710-722 Security Bdg.,
Minneapolis, Minn.
Cable: Longco Code: McNeill

LUCKE, P. K.
CONSULTING MINING ENGINEER
Avenida Isabela La Catolica, Num. 25,
Mexico City

LUNT, Horace F.
Commissioner of Mines for Colorado
Denver, Colo.
No professional work undertaken

MARSHALL, N. C.
MINING ENGINEER
Andagoya, via Buenaventura, Colombia,
South America

MATHEWSON, E. P.
CONSULTING ENGINEER
Non-Ferrous Metallurgy
42 Broadway, New York

MAYREIS, L. J.
MINING ENGINEER AND METALLURGIST
% Burma Mines, Ltd.,
Jamshedpur, India

MCCARTHY, E. T.
MINING ENGINEER
10 Austin Friars, London

McDERMOTT, E. D.
MINING ENGINEER
Rakka Mines P. O. District, Singbukum,
Chota Nagpur, India

McGREGOR, A. G.
ENGINEER
Design of Metallurgical Plants
Warren, Arizona

MEIN, William Wallace
MINING ENGINEER
43 Exchange Place, New York
Cable: Mein, New York

MERCER, John W.
MINING ENGINEER
General Manager South American Mines Co.,
Mills Bdg., Broad St., New York

MERRILL, Charles W.
METALLURGIST
121 Second St., San Francisco
Cable: Lurco Code: Bedford McNeill

MERRILL COMPANY, THE
ENGINEERS
121 Second St., San Francisco
Cable: Lurco Usual Codes

MILLER, G. W.
CONSULTING MIN. ENGR. AND GEOLOGIST
Examines mines and oil lands; Engineers work
of development and operation
721 S. Hope St., Los Angeles, Cal.

MILLS, Edwin W.
MINING ENGINEER
75 Yamashita-cho,
Yokohama, Japan
Telegrams: Edmills Usual Codes

MINARD, Frederick H.
MINING ENGINEER
21 East 40th St., New York
Cable: Frednard Code: McNeill

MITKE, Chas. A.
CONSULTING MINING ENGINEER
Mine Ventilation—Mining Methods
Bisbee, Arizona

MORRIS, F. L.
MINING ENGINEER
1057 Monadnock Bdg., San Francisco
Cable: Fredmor Code: McNeill

PROFESSIONAL DIRECTORY

MUDD, Seeley W.

MINING ENGINEER
1208 Hollingsworth Bdg., Los Angeles, Cal.

MUIR, N. M.

MINING ENGINEER
1024 Mills Bdg., San Francisco

MUNRO, C. H.

MINING ENGINEER
Ipoh, Perak, Federated Malay States
Cable: Ornum Code: McNeill

NEILL, James W.

METALLURGIST AND MINING ENGINEER
150 Pierpont St., Salt Lake City, Utah
Pasadena, Cal. Snelling, Cal.

NEWBERRY, Andrew W.

MINING ENGINEER
66 Broadway, New York

NEWMAN, M. A.

MINING ENGINEER
Union League Club, San Francisco, Cal.

NOWLAND, Ralph C.

Hobart Bdg., San Francisco
In charge Exploration Dept. of D. C. Jackling

PAYNE, Henry M.

CONSULTING MINING ENGINEER
1870 Hudson Terminal,
50 Church St., New York
Cable: Macpayne Usual Codes

PEARSE & CO., Arthur L.

CONSULTING MINING ENGINEERS
Coal and Shale Treatment
Worcester House, Walbrook, London, E.C.

PERKINS, Walter G.

METALLURGICAL ENGINEER
587 Mills Bdg., San Francisco

PLATE, H. Robinson

MINING ENGINEER
Hobart Bdg., San Francisco, Cal.
Code: Bedford McNeill

POILLON**POILLON & POIRIER**

MINING ENGINEERS
63 Wall St., New York

POMMERANTZ, K.

CONSULTING MINING ENGINEER
Casilla 480, Santiago de Chile
Cable: Kivapo, Santiago, Chile Code: McNeill

PRICHARD, W. A.

MINING ENGINEER
% Oroville Dredging, Limited,
Mills Bdg., San Francisco

PROBERT, Frank H.

MINING ENGINEER
University of California, Berkeley, Cal.

PURINGTON, C. W.

MINING ENGINEER
44 Svetlanskaya, Vladivostok, Russia
Cable: "Fedora" Code: A B C, 5th Edition

RICE, John A.

MINING GEOLOGIST
525 Market St., San Francisco

RICHARDS & LOCKE

MINING ENGINEERS—ORE TESTING
Tests for design of Flow Sheets
69 Massachusetts Ave., Cambridge, Mass.

RICKARD, Edgar

MINING ENGINEER
120 Broadway, New York

RICKARD, Forbes

MINING ENGINEER
Equitable Building, Denver

RICKARD, T. A.

Editor, Mining and Scientific Press
No professional work undertaken

RICKETTS, L. D.

CONSULTING ENGINEER
42 Broadway, New York

RIORDAN, D. M.

CONSULTING ENGINEER
Mining investigations carefully made for
responsible intending investors
525 Market St., San Francisco

RITTER, A. Etienne

MINING ENGINEER AND GEOLOGIST
Colorado Springs, Colo.

ROBERTS, Milnor

MINING ENGINEER
The Pacific Northwest
British Columbia and Alaska
University Station, Seattle, Wash.

ROBERTSON, Jasper T.

MINING ENGINEER
1108 Hobart Bdg., San Francisco
Code: McNeill

ROGERS, Edwin M.

CONSULTING MINING ENGINEER
32 Broadway, New York
Cable: Emrog Code: McNeill

ROGERS, John C.

MINING ENGINEER
Examination and Exploration of Mining Prop-
erties with a view to Purchase
Copper Cliff, Ontario. Code: Bedford McNeill

Allen H. Rogers Lucius W. Mayer
Sydney H. Ball

ROGERS, MAYER & BALL

MINING ENGINEERS
42 Broadway, New York
201 Devonshire St., Boston, Mass.
Cable: Alhasters

ROYER, Frank W.

MINING ENGINEER
1112 Hollingsworth Bdg., Los Angeles, Cal.
Cable: Royo Code: McNeill

RUTHERFORD, Forest

CONSULTING METALLURGICAL ENGINEER
120 Broadway, New York
Milling and Smelting Ores, especially of
Copper—Ore Smelting Contracts

SCOTT, Archibald B.

CONSULTING MINING AND
METALLURGICAL ENGINEER
First National Bank Bdg., Denver, Colo

SCOTT, Robert

INVENTOR AND BUILDER OF THE
SCOTT QUICKSILVER FURNACE
408 S. Eleventh St., San Jose, Cal

SEAGRAVE, W. H.

CONSULTING MINING ENGINEERS
L. C. Smith Bdg., Seattle

SEARS, Stanley C.

MINING ENGINEER
Reports, Consultation and Management
705 Walker Bank Bdg., Salt Lake City, Utah
Usual Codes

SHALER, Millard K.

MINING GEOLOGIST AND ENGINEER
6, Montagne du Parc,
Brussels, Belgium

SIMONDS, F. M.

MINING ENGINEER
25 Madison Ave., New York

SIMPSON, W. E.

MINING ENGINEER
Amos, Quebec, Canada
Fundicion de Los Arcos, Toluca, Mex.
P. O. Box 160, Cobalt, Ontario

SIZER, F. L.

CONSULTING MINING ENGINEER
1006 Hobart Bdg., San Francisco

SMITH, Howard D.

MINING ENGINEER
60 Broadway, New York
Cable: Diorite Code: Western Union

SMITH & ZIESEMER

MINING ENGINEERS
Franklin W. Smith Ralph A. Ziesemer
Bisbee, Ariz. Code: McNeill

SPILSBURY, E. Gybbon

CONSULTING MINING AND METAL-
LURGICAL ENGINEER
29 Broadway, New York
Cable: Spilroe

SPURR, J. Edward

Editor, Engineering and Mining Journal,
New York City

STAVER, W. H.

MINING ENGINEER
15 Broad St., New York City
Cable: Revatso

PROFESSIONAL DIRECTORY

STEBBINS, Elwyn W.
MINING ENGINEER
819 Mills Bdr., San Francisco

STEVENS, Arthur W.
MINING ENGINEER
Atlanta, Idaho

STEVENS, Blamey
CONSULTING MINING ENGINEER
Apartado 1620, Mexico City

STEWART, R. H.
MINING AND METALLURGICAL ENGINEER
Vancouver Block, Vancouver, B. C.

STINES, Norman C.
MINING ENGINEER
4, Moorgate Street, London, E.C. 2
Codes: McNeill (both Editions) and Bentley's

STRAUSS, Lester W.
ENGINEER OF MINES
Casilla 514, Valparaiso, Chile, S. A.
Cable: Lestra-Valparaiso Code: McNeill

SUMMERHAYES, Maurice W.
MINING ENGINEER
Mgr. Bluestone Mining & Smelting Co.,
Mason, Nevada

SWIFT, Ernest Lee
MINING ENGINEER AND GEOLOGIST
624 Kohl Bdg., San Francisco
Cable Address: Leswif Code: Bedford McNeill

SYMMES, Whitman
MINING ENGINEER
Pres. and Mgr. Con Virginia, Ophir, Mexican,
Union Consolidated, etc.
Virginia City, Nevada

Arthur F. Taggart R. B. Yerxa
TAGGART & YERXA
CONSULTING ENGINEERS
Operation and design of ore treatment plants
Laboratory, 165 Division St., New Haven, Conn.

TALBOT COMPANY, E. W.
Contractors and Engineers
DIAMOND DRILLING CONTRACTING
1108 Hobart Bdg., San Francisco
Code: McNeill

TALMAGE, Sterling B.
MINING GEOLOGIST AND ENGINEER
Geologic Maps, Examinations, Reports
315 Judge Bdg., Salt Lake City, Utah

TELLAM, Alfred
METALLURGICAL ENGINEER
Denver Engineering Works Company
Denver, Colorado

THOMSON, S. C.
CONSULTING MINING ENGINEER
45 Exchange Place, New York

THORNE, W. E.
MINING ENGINEER
% Ropp Tin Ltd., P. O. Naraguta,
N. Nigeria, W. Africa
Codes: McNeill, both Editions

TITCOMB, H. A.
MINING ENGINEER
% A. Chester Beatty, 25 Broad St., New York
Code: Bedford McNeill

TURNER, H. W.
MINING GEOLOGIST
Mills Bdg., San Francisco
Cable: Latite Code: Bedford McNeill

TURNER, J. K.
MINING ENGINEER
Goldfield, Nevada

TURNER, Scott
1511 Bank of Hamilton Bdg.,
Toronto, Ontario, Canada

TYRRELL, J. B.
MINING ENGINEER AND GEOLOGIST
534 Confederation Life Bdg., Toronto, Canada
208 Salisbury House, London, E.C. 2, England

VAN LAW, Carlos W.
% Sinclair Consolidated Oil Corp.,
120 Broadway, New York

WALLACE, H. Vincent
MINING ENGINEER
329 Central Building
Los Angeles, California

WARRINER, R. C.
CONSULTING MINING ENGINEER
42 Exchange Place, New York

WEATHERBE, D'Arcy
MINING ENGINEER
14 Cophall Ave., London, E.C., 2
And Peking, China
Cable: Natchekoo, London

WEBBER, Morton
MINE VALUATION AND DEVELOPMENT
165 Broadway, New York
O'Rourke Estate Bdg., Butte, Montana

WEEKES, Frederic R.
MINING ENGINEER
233 Broadway, New York

WEIGALL, Arthur R.
MINING ENGINEER
General Manager The Seoul Mining Co.
Tul Mi Chung (Nantei)
Whang Hai Province, Chosen (Korea)

WESTERVELT, William Young
CONSULTING MINING ENGINEER
17 Madison Ave. (Madison Square East)
New York
Cable: Casewest Code: McNeill

WHITE, Charles H.
CONSULTING GEOLOGIST
788 Mills Bdg., San Francisco

WHITE, J. E.
CONSULTING ENGINEER
Bothin Bdg., Santa Barbara, California

Burch, Hershey & White
WHITE, Lloyd C.
CONSULTING ENGINEER
Crocker Bdg., San Francisco

WHITMAN, Alfred R.
MINING GEOLOGIST
Underground Programmes, Orebody Problems
43 Exchange Place, New York
Haileybury, Ontario (Cobalt District)

WICKS, Frank R.
CONSULTING ENGINEER
Ore Treatment, Test Work, Plant Supervision
7034 Holmes Ave., Los Angeles, Cal.

WILEY, W. H.
MINING ENGINEER
Palm Drive, Glendora, Cal.

J. H. Devereux W. B. Devereux, Jr.
WILKENS and DEVEREUX
CONSULTING MINING ENGINEERS
London 120 Broadway, N. Y. Mexico, D. F.
Cable: Kenreux Code: Bedford McNeill

WINCHELL, Horace V.
CONSULTING MINING GEOLOGIST
1212 First National-Soo Line Bdg.,
Minneapolis, Minn.
Cable: Racewin

WINWOOD, Job H.
MINING ENGINEER
Continental Bank Bdg., Salt Lake City, Utah

WISEMAN, Philip
MINING ENGINEER
1210 Hollingsworth Bdg., Los Angeles
Cable: Filwiseman Codes: W. U.; McNeill

WRIGHT, Charles Will
MINING ENGINEER
Ingurtoeu, Sardinia, Italy
Cable: Wright, Arbus Code: McNeill

WRIGHT, Louis A.
MINING ENGINEER
Via Parlamento 22, Rome, Italy

WROTH, James S.
MINING ENGINEER
42 Broadway, New York

Pope Yeatman Edwin S. Berry
YEATMAN & BERRY
CONSULTING MINING ENGINEERS
Examination, Development and Management
of Properties
Room 706, 111 Broadway, New York
Cable: Ikona Code: Bedford McNeill

YOUNG, E. J.
CONSULTING GEOLOGIST AND ENGINEER
Offices and Laboratory
Story Bdg., Los Angeles, California, U. S. A.
Examinations and Reports on all Mineral
Deposits, Formations and Processes
of Extraction
20 years experience in the Western States,
Pacific Coast States, U. S. A., Mexico
and Central America

ZIEGLER, Victor
GEOLOGICAL ENGINEER
Examination of oil lands and mineral deposits
Geologic and structural maps
415 Empire Bdg., Denver, Colo.



Send for Catalogs
and Prices

Here is what one drill
operator says about
the **LONGYEAR "U G" DIAMOND
DRILL**

"I'm still on the job running
your new screw feed. She sure
is a dandy and we are getting
from three to five feet more per
shift since its arrival. I have not
seen anything yet to compare
with it. It has all the advantages
of a hydraulic."

A drill for every purpose.

Send for Catalogues and prices

E. J. LONGYEAR COMPANY

Branch Office, TUCSON, ARIZ.

MINNEAPOLIS, MINNESOTA

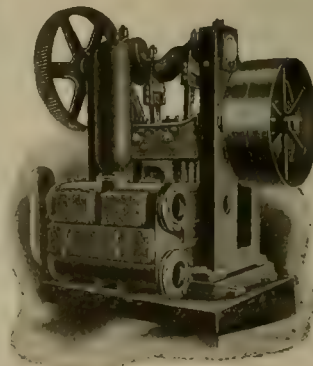
WE TAKE THIS OPPOR-
TUNITY TO WISH YOU,
WHOSE BUSINESS HELPS
TO MAKE OURS
SUCCESSFUL,

**A HAPPY AND
PROSPEROUS
NEW YEAR**

AND THANK YOU
FOR PAST FAVORS

E. D. BULLARD
268 MARKET STREET
SAN FRANCISCO, CAL.

Aldrich Pumps For General Service



A Divided Water-
End Type, arranged
to be operated by
belt from motor or
from countershaft,
Designed for large
quantities of water,
and for lifts not ex-
ceeding 350 feet.
Especially adapted
for water supply
service in mills,
sugar refineries,
municipal water-
works, etc. Built

in capacities of from 350 to 1800 G. P. M. against lifts
up to 350 feet. Write for data.

The Aldrich Pump Company

Allentown, Pa., U. S. A.

CHICAGO, ILL.
McCormick Building

NEW YORK CITY
30 Church Street

PITTSBURGH, PA.
Keenan Building

ASSAYERS CHEMISTS AND ORE-TESTING WORKS



ARIZONA ASSAY OFFICE

(F. W. Libbey)
Assayers, Chemists and Metallurgists
CONTROL AND UMPIRE WORK
305-307 N. First St., Phoenix, Arizona

ATKINS & McRAE

Assayers, Chemists and Metallurgists
CONTROL AND UMPIRE ASSAYS
Flotation and Cyanide Tests
1008 South Hill St., Los Angeles, Cal.

BARDWELL, Alonzo F.

CUSTOM ASSAYER AND CHEMIST
(Successor to Bettles & Bardwell)
158 S. W. Temple St., Salt Lake City, Utah
Ore Shippers' Agent

BAVERSTOCK & PAYNE

INDUSTRIAL CHEMISTS AND ASSAYERS
Technical and Chemical Analysis of Ores
Minerals, and All Organic Materials
223 W. First St., Los Angeles, Cal.

BECKMAN & LINDEN ENG. CORP.

Chemical, electro-chemical, metallurgical and
electro-metallurgical investigations and
reports. Processes developed
604 Balboa Bldg., San Francisco

COLE & CO.

ASSAYERS, CHEMISTS, ORE BUYERS
Shippers' Representatives
Box BB, Douglas, Arizona

CRITCHETT & FERGUSON

ASSAYERS AND CHEMISTS
El Paso, Texas
Umpire and Controls a Specialty

DWIGHT & LLOYD SINTERING CO.

Special problems in ore treatment
29 Broadway, New York City
Cable Address: Sinterer

ERMLICH & CO., Geo. J.

ASSAYERS AND CHEMISTS
Control and Umpire Work
Ore Shippers' Agent
1725 Champa St., Denver, Colo.

FROST, Oscar J.

ASSAYER
420 18th St., Denver

GIBSON, Walter L.

Successor to
FALKENAU ASSAYING CO.,
ASSAY OFFICE AND ANALYTICAL
LABORATORY, SCHOOL OF ASSAYING
824 Washington St., Oakland
Phone 8929

Umpire assays and supervision of sampling.
Working tests of ores, analysis. Investigations
of metallurgical and technical processes.
Professor L. Falkenau, General Manager and
Consulting Specialist.

GOVE & COMPANY

ASSAYERS AND CHEMISTS
Umpires and Controls a Specialty
Box 1736, Picher, Okla.

GENERAL ENGINEERING CO., THE

J. M. CALLOW, President

CONSULTING ENGINEERS

159 Pierpont Avenue, Salt Lake City, Utah

Design and Erection of all Classes of Reduction Plants

ORES TESTED IN SMALL OR 10-TON LOTS BY AMALGAMATION, CONCENTRATION,
CYANIDATION, MAGNETIC SEPARATION, FLOTATION

The 4th edition of our Ore Testing Bulletin is now ready for mailing. We shall be pleased to
send it to you upon request

New York Office, 120 Broadway, Room 2817. C. E. Chaffin, Local Manager

Canadian Office, 363 Sparks St., Ottawa, Canada

Australian Agent: F. H. Jackson, 22 Carrington St., Wyward Square, Sydney, N. S. W., Australia

HAMILTON, BEAUCHAMP, WOODWORTH, Inc.

METALLURGICAL ENGINEERS

SPECIALTY: THE TREATMENT OF GOLD AND SILVER ORES, BY FLOTATION, BY
CYANIDE, OR BY A COMBINATION OF BOTH PROCESSES

Flotation of Copper, Lead, Zinc, and Other Minerals

Tests made on Lots of 1 lb. up to 5 Tons

MILLS DESIGNED AND CONSTRUCTED, CONSULTING AND EXPERT WORK UNDERTAKEN

Laboratory and Office: 419 The Embarcadero, San Francisco

Telephone: Sutter 5266 Cable address: Hambeau Codes: West. Union; Bed. McNeill

LEDoux & CO., Inc.

ASSAYERS, CHEMISTS AND METALLURGISTS

Independent samplers at the port of New York
Representatives at all Refineries and Smelters on Atlantic Seaboard
Office and Laboratory: 99 John Street, New York

SMITH, EMERY & CO.

(Ore Testing Plant, Los Angeles)

INDEPENDENT CONTROLS AND UMPIRE ASSAYERS

Represent Shippers at Smelters, Test Ores, and Design Mills

651 Howard Street, San Francisco 245 South Los Angeles Street, Los Angeles

NEW MEXICO STATE SCHOOL OF MINES

An Institution of Technology and Engineering. Full degrees, low cost, fine climate, new
equipment, accessible to mines and smelters. Write for catalogue.

A. X. ILLINISKI, PRESIDENT, SOCCORO, NEW MEXICO

HANKS, Abbott A.

CHEMIST AND ASSAYER

Established 1866

630 Sacramento St., San Francisco

Control and Umpire Assays, Supervision of
Sampling at Smelters

Cable: Hanx Code: W. U. and Bed. McN.

OFFICER & CO., R. H.

ASSAYERS AND CHEMISTS
Oils, Hydrocarbons and Oil Shale Analysis
169 South West Temple Street,
Salt Lake City, Utah

PEREZ, Richard A.

ASSAYER, CHEMIST AND
METALLURGIST
(Established 1895)
120 N. Main St., Los Angeles, Cal

IRVING & CO., James

ASSAYERS and GOLD BUYERS
Mines Examined

702 South Spring St., Los Angeles, Cal.

Wm. P. Miller

C. W. Neff

JAMES CO., THE GEORGE A.

METALLURGISTS AND MINING
ENGINEERS

ASSAYERS AND CHEMISTS

Mines Examined and Reported On

Processes Investigated, Mills Designed

Laboratory, 28 Belden Place, San Francisco

RICHARDS, J. W.

ASSAYER AND CHEMIST
1115 Nineteenth St., Denver
Ore Shippers' Agent. Write for terms
Representatives at all Colorado smelters

THE TWINING LABORATORIES

ASSAYERS AND CHEMICAL
ENGINEERS
Fresno, Cal.

WALKER, Mark

CHEMIST, ASSAYER AND METALLURGIST
Suite 619 Wesley Roberts Bdg.,
Third and Main Sts., Los Angeles, Cal.

LAUCKS, I. F.

(Established 1908)

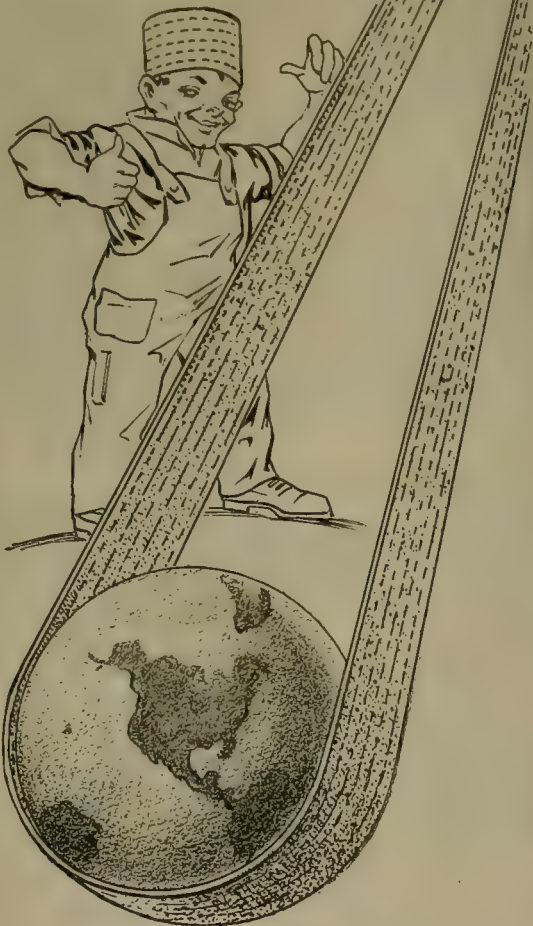
Chemists, Assayers, Metallurgists
Shippers' Representatives at Smelters
89 Marion St., Seattle, Wash.

THE BOOK DEPARTMENT of THE MINING
AND SCIENTIFIC PRESS carries a complete
line of Technical Books on all subjects allied
to the Mining Field.

GANDY BELTS keep the world revolving

Gandy Original Stitched Cotton Duck Power and Conveyor Belts have been giving service indoors and out, the world over for more than forty years.

Use our Engineering Department to secure the size and ply Gandy Be't best suited to your particular work—and to be sure of the genuine Gandy Belt, look for the Green Edge and Gandy Trademark.



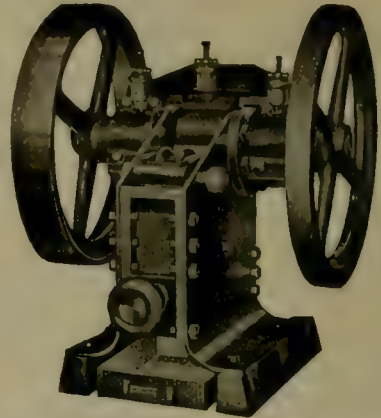
Orders filled promptly from Mill Supply House or direct.

GANDY BELTING COMPANY

755 West Pratt St., Baltimore, Md.
New York Branch: 36 Warren St.



B BRAUN B CHIPMUNK CRUSHERS



In Two Sizes for Laboratory Purposes

Built with STEEL FRAMES for STRENGTH,
LIGHTNESS, DURABILITY.

GREATER CAPACITY for size of jaws than
any other CRUSHING DEVICE.



Sectional View Showing Jaws and Adjustment.

WRITE FOR BULLETIN S-127

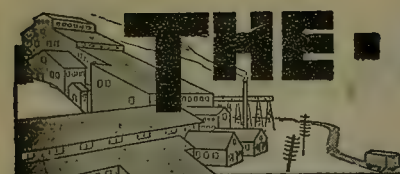
BRAUN-KNECHT-HEIMANN-CO.

San Francisco, U. S. A.

THE
BRAUN CORPORATION

Los Angeles, U. S. A.

Manufacturers of Laboratory Labor Saving Machinery
Specialists in Laboratory Equipment and Testing Apparatus
Dealers in Chemical Glassware and Chemicals



THE-BUYER'S-GUIDE

Machinery and Supplies of Dependable Manufacturers are here Listed
Addresses will be found on the Sixth following Page ...
If you do not find what you want, communicate with MINING and SCIENTIFIC PRESS SERVICE

Acetylene Generators

Bullard, E. D.
Oxfield Acetylene Co.

Agitators

Buttress & McClellan
Chalmers & Williams
Collins & Webb, Inc.
Dorr Co., The
Meese & Gottfried Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Trent, Goodwin M.

Air Receivers

Buttress & McClellan
Chicago Pneumatic Tool Co.
Collins & Webb, Inc.
Galigher Machinery Co.
Ingersoll-Rand Co.
Reardon, P. H.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Amalgamating Plates

Buttress & McClellan
Denver Engineering Works Co.
Gibson, W. W.
Morse Bros. Machy. & Sup. Co.
San Francisco Plating Works
Simpson Co., A. H.
Worthington Pump & Mach. Corp.

Amalgamators

Mine & Smelter Supply Co.
Senn Concentrator Co.

Assayers' and Chemists' Supplies

Bartley Crucible Co., Jonathan
Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Engineering Works Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.
(See Index to Advertisers)

Babbitt Metals

Finn Metal Works, John

Bags

Braun Corporation, The
Braun-Knecht-Heimann Co.

Balances and Weights

Ainsworth & Sons, Wm.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Fairbanks, Morse & Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Thompson Balance Co.

Balls for Ball-Mills

Bethlehem Shipbuilding Corp., Ltd.
Chalmers & Williams
Denver Engineering Works Co.
Hardinge Conical Mill Co.
Hickok & Hickok
Los Angeles Foundry Co.
Mine Equipment & Supply Co.

Ball-Mills (see 'Mills')

Bells

Garratt & Co., W. T.

Belting and Lacing

Diamond Rubber Co., Inc.
Dodge Sales & Engineering Co.
Fairbanks, Morse & Co.
Flexible Steel Lacing Co.
Gandy Belting Co.
Goodrich Rubber Co., B. F.
Main Belting Co.
Meese & Gottfried Co.
Pioneer Rubber Mills
United States Rubber Co.

Blowers

Allis-Chalmers Mfg. Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.

Blowing Engines

Nordberg Mfg. Co.

Boilers

Bethlehem Shipbuilding Corp., Ltd.
Buttress & McClellan
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.

Bolts and Nuts

Drake Lock Nut Co.

Books, Technical

Mining and Scientific Press

Brick, Fire

Atkins, Kroll & Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

Briquetting Machinery

General Briquetting Co.
Traylor Eng. & Mfg. Co.

Buckets

Atlas Car & Mfg. Co.
Dodge Sales & Engineering Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Meese & Gottfried Co.
Mine & Smelter Supply Co.
Simpson Co., A. H.
Wellman-Seaver-Morgan Co.

Burners, Oil

Braun Corporation, The
Braun-Knecht-Heimann Co.
Lunkenheimer Co., The
Mine & Smelter Supply Co.

Cages

Atlas Car & Mfg. Co.
Denver Engineering Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Wellman-Seaver-Morgan Co.

Calculating Machines

Marchant Calculating Machine Co.
Monroe Calculating Machine Co.

Carbide Flare Lights

Bullard, E. D.

Carbons, Borts, and Diamonds

Atkins, Kroll & Co.

Cars

Allis-Chalmers Mfg. Co.
Atlas Car & Mfg. Co.
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Kansas City Structural Steel Co.
Mine & Smelter Supply Co.
Simpson Co., A. H.
Wellman-Seaver-Morgan Co.

Chain

Dodge Sales & Engineering Co.
Meese & Gottfried Co.

Chemicals

Barrett Co., The
Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Giant Powder Co.
Hercules Powder Co.
Mine & Smelter Supply Co.
Roessler & Hasslacher Chem. Co.

Chisel Mills (see 'Mills')

Classifiers

Allis-Chalmers Mfg. Co.
Chalmers & Williams
Colorado Iron Works Co.
Deister Machine Co.
Denver Engineering Works Co.
Dorr Co., The
Meese & Gottfried Co.
Pacific Tank & Pipe Co.
Traylor Eng. & Mfg. Co.

Classifiers, Dry

National Milling & Refining Co.

Clutches, Friction (see 'Transmission Machinery')

Compressor

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chalmers & Williams
Chicago Pneumatic Tool Co.
Collins & Webb, Inc.
Fairbanks, Morse & Co.
Gardner Governor Co.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Jackson Compressor Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Norwalk Iron Works
Pratt-Gilbert Co.
Reardon, P. H.
Rix Compressed Air & Drill Co.
Rosenberg & Co.
Simpson Co., A. H.
Sullivan Machinery Co.
Western Machinery Co.
Worthington Pump & Mach. Corp.

Concentrators

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Deister Concentrator Co.
Deister Machine Co.
Denver Engineering Works Co.
Dings Magnetic Separator Co.
Gibson, W. W.
Hendrie & Bolthoff Mfg. & Sup. Co.
James Ore Concentrator Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Overstrom Mfg. Co.
Senn Concentrator Co.
Simpson Co., A. H.
Traylor Eng. & Mfg. Co.
Young & Tyler

Concentrators, Dry

National Milling & Refining Co.
Young & Tyler

Concrete Mixers

Buttress & McClellan
Worthington Pump & Mach. Corp.

Contractors, Core Drilling

Sullivan Machinery Co.

Converters

Allis-Chalmers Mfg. Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Traylor Eng. & Mfg. Co.

Conveyors, Belt or Screw

Allis-Chalmers Mfg. Co.
Diamond Rubber Co., Inc.
Dodge Sales & Engineering Co.
Galigher Machinery Co.
Gandy Belting Co.
Goodrich Rubber Co., B. F.
Meese & Gottfried Co.
Pioneer Rubber Mills
United States Rubber Co.

Cranes

Chicago Pneumatic Tool Co.
Wellman-Seaver-Morgan Co.

Crucibles

Bartley Crucible Co., Jonathan
Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.

Crushers

Allis-Chalmers Mfg. Co.
Bacon, Inc., Earle C.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Buttress & McClellan
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Denver Engineering Works Co.
Denver Fire Clay Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Traylor Eng. & Mfg. Co.

Worthington Pump & Mach. Corp. Young & Tyler

Cupels

Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Fire Clay Co.
Dixon Crucible Co., Joseph
Mine & Smelter Supply Co.

Cyanide

Roessler & Hasslacher Chem. Co.

Cyanide Plants and Machinery

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Buttress & McClellan
Collins & Webb, Inc.
Colorado Iron Works Co.
Dorr Co., The
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
National Tank & Pipe Co.
Oliver Filter Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.
Traylor Eng. & Mfg. Co.
Trent, Goodwin M.
Worthington Pump & Mach. Corp.

Dewaterers

Chalmers & Williams
Colorado Iron Works Co.
Dorr Company, The
Morse Bros. Machy. & Sup. Co.
Oliver Continuous Filter Co.
Traylor Eng. & Mfg. Co.

Drafting Material

Ainsworth & Sons, Wm.
Dixon Crucible Co., Joseph

Dragline Excavators

Buttress & McClellan
Collins & Webb, Inc.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.

Dredges and Accessories

Bethlehem Shipbuilding Corp., Ltd.
Hendrie & Bolthoff Mfg. & Sup. Co.
Hickok & Hickok
Leschen & Sons Rope Co., A.
Morris Machine Works
New York Engineering Co.
Senn Concentrator Co.
Union Construction Co.
Wellman-Seaver-Morgan Co.
Yuba Mfg. Co.

Drill Makers and Sharpeners

Collins & Webb, Inc.
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Air and Steam

Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co.
Collins & Webb, Inc.
Cochise Machine Co.
Denver Rock Drill Mfg. Co.
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Reardon, P. H.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Drills, Core

Dobbie Core Drill Co.
Ingersoll-Rand Co.
Longyear Co., E. J.
Sullivan Machinery Co.

Drills, Diamond

Ingersoll-Rand Co.
Longyear Co., E. J.
Sullivan Machinery Co.

Dryers

Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.
National Milling & Refining Co.
Traylor Eng. & Mfg. Co.

Dumps, Rotary

Car-Dumper & Equipment Co.

(Continued on page 60)

YOUR "OVERHEAD"

B. & B. Aerial Tramways

reduce your overhead by operating overhead—by taking the direct bee line—by lifting your haulage off the earth, where it is affected by weather conditions, into the air where nothing affects continuous operation.

B. & B. Aerial Tramways are installed at reasonable cost. Up-keep is low. Economy is sure.

Get Catalog 45.

BRODERICK & BASCOM ROPE CO.

New York

ST. LOUIS

Seattle

TUBE MILL LININGS

SILEX USERS

OUR "ADAMANT SILICA" IS BEST

Outwears same weight metal linings

DIRECT FROM PRODUCER—REDUCED COST

RIGHT SIZE—AS DESIRED

GRINDING PEBBLES OF SAME MATERIAL
ARE MOST EFFICIENT

STOCK SIZES IMMEDIATE SHIPMENT

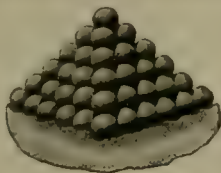
PRICES AND FREIGHT RATES ON REQUEST

JASPER STONE COMPANY

204 LYTLE BLDG.

SIOUX CITY, IOWA

Safety
First



Use
Proven

Duroloid

Grinding Balls and Mill Liners

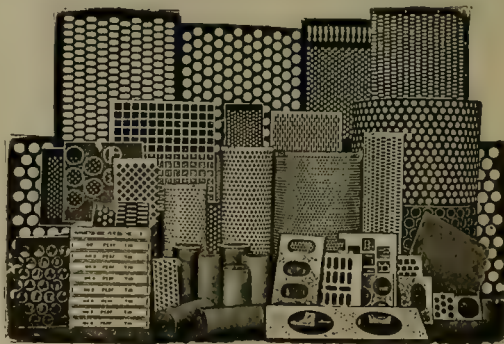
We guarantee these where recommended by us to reduce **your** ore on a dollar for dollar basis with any other grinding material used in the same mill under same conditions.

LOS ANGELES FOUNDRY CO.

2444 So. Alameda - - Los Angeles, Cal.

Perforated Steel Screens

Of Every Description



For TROMMELS—JIGS—CHUTES
STAMP AND GRINDING MILLS
FILTERING—DEWATERING, Etc.

Made for Service

The Harrington & King Perforating Co.

637 N. Union Ave., Chicago, Ill.

NEW YORK OFFICE: 114 Liberty St.

THE BUYER'S GUIDE

Electrical Supplies

Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Employment Bureau

Business Mens Clearing House

Engineers (Designing and Contracting)

General Engineering Co.
Kansas City Structural Steel Co.
Wellman-Lewis Co.

Engines, Internal Combustion

Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Collins & Webb, Inc.
Fairbanks, Morse & Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Novo Engine Co.
Reardon, F. H.
Rix Compressed Air & Drill Co.
Western Machinery Co.

Engines, Steam

Allis-Chalmers Mfg. Co.
Galigher Machinery Co.
Morris Machine Works
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rosenberg & Co.
Simpson Co., A. H.

Explosives

Du Pont Powder Co.
Grant Powder Co.
Hercules Powder Co.

Fans, Ventilating

Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.

Filters

Braun Corporation, The
Braun-Knecht-Heimann Co.
Chalmers & Williams
Colorado Iron Works Co.
Galigher Machinery Co.
Merrill Co., The
Morse Bros. Machy. & Sup. Co.
Oliver Continuous Filter Co.
United Filters Corp.
Worthington Pump & Mach. Corp.

Filter Presses

Braun Corporation, The
Braun-Knecht-Heimann Co.
Buttress & McClellan
Galigher Machinery Co.
Merrill Co., The
Morse Bros. Machy. & Sup. Co.
United Filters Corp.
Worthington Pump & Mach. Corp.

Fire Extinguishers

Bullard, E. D.
Justite Mfg. Co.

First Aid Equipment

Braun Corporation, The
Braun-Knecht-Heimann Co.
Bullard, E. D.

Flotation Apparatus

Braun Corporation, The
Braun-Knecht-Heimann Co.
Butchart, W. A.
Butters Co., Ltd., Chas.
Denver Engineering Works Co.
Galigher Machinery Co.
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Overstrom Mfg. Co.
Senn Concentrator Co.
Southwestern Eng. Co.
Simpson Equipment Co.

Forges

Buttress & McClellan
Camden Forge Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.

Frogs and Switches (see 'Railway Supplies')

Fuel Oil

Standard Oil Co.

Furnaces, Assay (see 'Assayers and Chemists Supplies')

Furnaces, Roasting and Smelting
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.

Denver Engineering Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Gas Producers

Wellman-Seaver-Morgan Co.

Gears

Chicago Pneumatic Tool Co.
Denver Engineering Works Co.
Dodge Sales & Engineering Co.
General Electric Co.
Johnson Gear Works
Meese & Gottfried Co.

Generators, Electric

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Collins & Webb, Inc.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Sup. Co.
Westinghouse Elec. & Mfg. Co.

Giants, Hydraulic (see 'Hydraulic Mining Machinery')

Governors

Gardner Governor Co.

Graphite Products

Bartley Crucible Co., Jonathan
Detroit Graphite Co.
Dixon Crucible Co., Joseph

Grinders, Laboratory

Braun Corporation, The
Braun-Knecht-Heimann Co.
Denver Engineering Works Co.

Heaters, Feed Water

Allis-Chalmers Mfg. Co.
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.

Holsts, Electric

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chicago Pneumatic Tool Co.
Collins & Webb, Inc.
Denver Engineering Works Co.
Galigher Machinery Co.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Rosenberg & Co.
Simpson Co., A. H.
Wellman-Seaver-Morgan Co.
Westinghouse Elec. & Mfg. Co.

Holsts, Oil and Distillate

Buttress & McClellan
Collins & Webb, Inc.
Denver Engineering Works Co.
Galigher Machinery Co.
Leschen & Sons Rope Co., A.
Simpson Co., A. H.
Western Machinery Co.

Holsts, Steam or Air

Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Collins & Webb, Inc.
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Leschen & Sons Rope Co., A.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
Wellman-Seaver-Morgan Co.

Hose

Buttress & McClellan
Chicago Pneumatic Tool Co.
Cochise Machine Co.
Denver Rock Drill Mfg. Co.
Diamond Rubber Co., Inc.
Galigher Machinery Co.
General Electric Co.
Goodrich Rubber Co., B. F.
Ingersoll-Rand Co.
Pioneer Rubber Mills
Rix Compressed Air & Drill Co.
Simpson Co., A. H.
United States Rubber Co.

Hydraulic Mining Machinery

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
American Spiral Pipe Works
Garritt & Co., W. T.
New York Engineering Co.
Overstrom Mfg. Co.
Pelton Water Wheel Co.
Sacramento Pipe Works
Senn Concentrator Co.

Ice Machines

Norwalk Iron Works

Injectors

Galigher Machinery Co.
Lunkenheimer Co., The
Morse Bros. Machy. & Sup. Co.
Powell Co., Wm.

Iron Cements

Smooth-On Mfg. Co.

Jigs

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chalmers & Williams
Colorado Iron Works Co.
Denver Engineering Works Co.
Morse Bros. Machy. & Sup. Co.
National Milling & Refining Co.
New York Engineering Co.
Overstrom Mfg. Co.
Senn Concentrator Co.
Traylor Eng. & Mfg. Co.
Union Construction Co.

Kilns

Allis-Chalmers Mfg. Co.

Laboratory Supplies (see 'Assayers' and 'Chemists' Supplies')

Lamp Guards

Flexible Steel Lacing Co.

Lamps, Arc and Incandescent

General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Miners'

Braun Corporation, The
Braun-Knecht-Heimann Co.
Bullard, E. D.
Justite Mfg. Co.
Pratt-Gilbert Co.
Wolf Safety Lamp Co.

Lining for Ball-Mills

Chalmers & Williams
Hardinge Conical Mill Co.
Hickok & Hickok
Jasper Stone Co.
Los Angeles Foundry Co.
Traylor Eng. & Mfg. Co.

Linoleum

Overstrom Mfg. Co.
Paraffine Companies, Inc.

Lock Nuts

Drake Lock Nut Co.

Locomotives, Electric

Atlas Car & Mfg. Co.
Collins & Webb, Inc.
General Electric Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Westinghouse Elec. & Mfg. Co.

Locomotives, Compressed Air

Porter Co., H. K.

Locomotives, Gasoline

Fate-Root-Heath Mfg. Co.

Locomotives, Steam

Morse Bros. Machy. & Sup. Co.
Porter Co., H. K.
Simpson Co., A. H.

Lubricants

Chicago Pneumatic Tool Co.
Dixon Crucible Co., Joseph
Harron, Rickard & McCone
Standard Oil Co.

Lubricators

Chicago Pneumatic Tool Co.
Justite Mfg. Co.
Lunkenheimer Co., The
Powell Co., Wm.

Machinery, Used

Buttress & McClellan
Collins & Webb, Inc.
Jardine Machinery Co.
Morse Bros. Machy. & Sup. Co.
Nevada Engineering & Supply Co.
Pacifi Pipe Co.

Rebuilt Machinery Co.
Rosenberg & Co.
Simpson Co., A. H.
Western Machinery Co.
Zelickler Supply Co.

Magnets, Lifting

Dings Magnetic Separator Co.

Magnetic Separators and Pulleys

Dings Magnetic Separator Co.

Metal Buyers and Dealers

American Smelters Securities Co.
American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
Empire Zinc Co.
Grubnau, Bryant & Grubnau
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Mills—Ball, Pebble and Tube

Allis-Chalmers Mfg. Co.
Bethlehem Shipbuilding Corp., Ltd.
Buttress & McClellan
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Denver Engineering Works Co.
Denver Fire Clay Co.
Hardinge Conical Mill Co.
Herman, John
Mine & Smelter Supply Co.
Mine Equipment & Supply Co.
Morse Bros. Machy. & Sup. Co.
Rosenberg & Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Mills, Chilean

Allis-Chalmers Mfg. Co.
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Denver Quartz Mill & Crusher Co.
Lane Mill & Machinery Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Wellman-Seaver-Morgan Co.
Worthington Pump & Mach. Corp.

Mills, Grinding

Gibson, W. W.
Marathon Mill & Machine Works

Mills, Stamp

Allis-Chalmers Mfg. Co.
Bethlehem Shipbuilding Corp., Ltd.
Buttress & McClellan
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Motor Trucks

Garford Motor Truck Co.
Mutual Truck Co.
White Co., The

Motors

Allis-Chalmers Mfg. Co.
Buttress & McClellan
Collins & Webb, Inc.
Fairbanks, Morse & Co.
Galigher Machinery Co.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Rosenberg & Co.
Simpson Co., A. H.
Westinghouse Elec. & Mfg. Co.

Nodulizers, Ore

Allis-Chalmers Mfg. Co.

Office Supplies

Dixon Crucible Co., Joseph
Marchant Calculating Machine Co.
Monroe Calculating Machine Co.

Oil and Grease Cups (see 'Lubricators')

Oil, Flotation

Barrett Co., The
General Naval Stores
Pensacola Tar & Turpentine Co.
Standard Oil Co.
United Naval Stores

Ore-Buyers (see 'Metal Buyers and Dealers')

Oxy-Acetylene Welding and Cutting Apparatus

Bullard, E. D.
Galigher Machinery Co.
Oxweld Acetylene Co.

(Continued on page 62)

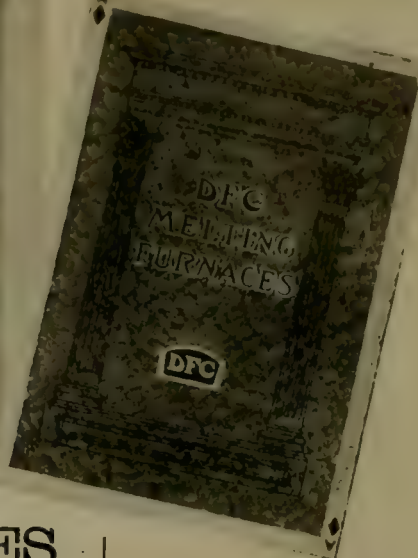


ANY OF WHICH WILL BE
SENT YOU UPON REQUEST

CHINA KILNS



LONG LIFE
ECONOMY
PERFECT RESULTS
Consistent Quality



THREE ACES HARD TO BEAT

SEND US A POSTAL TODAY
WITH YOUR SELECTION

THE DENVER FIRE CLAY CO.

SALT LAKE CITY

DENVER, COLORADO, U. S. A.

NEW YORK CITY

KANSAS CITY STRUCTURAL STEEL COMPANY

KANSAS CITY, MO.

STRUCTURAL STEEL FOR MINE, MILL AND SMELTER BUILDINGS
TANKS TANK CARS

COMPLETE WAREHOUSE STOCKS

BEAMS, CHANNELS, ANGLES, BARS, PLATES, SHEETS, REINFORCING BARS

WRITE FOR OUR MONTHLY STOCK LIST



Hydraulic Mining, Yukon Gold Co.
Water Supplied Through

Taylor Spiral Riveted Pipe

"New York, Jan. 16, 1911.
"Gentlemen: We beg to acknowledge yours of Jan. 9th,
making inquiry as to our experience with your Spiral Riveted
Pipe.

"Our first use of Spiral Riveted Pipe was in connection
with our hydraulic mining operations as distributing lines
from our main ditch system. The pipe was given severe
service and proved entirely satisfactory. We are now using
it in diameters up to 42 inches and heads up to 530 feet.
We have found the pipe easy to lay and handle, strong for
its weight and generally satisfactory.

"Very truly yours,
(Signed) YUKON GOLD CO.,
"O. B. Perry, Gen. Mgr."

Catalogue and special prices on request.

AMERICAN SPIRAL PIPE WORKS
Chicago, Ill.

THE BUYER'S GUIDE

Oxygen Apparatus

Bullard, E. D.
Siebe, Gorman Co., Ltd.

Packing

Diamond Rubber Co.
Goodrich Rubber Co., B. F.
Pioneer Rubber Mills
Smooth-On Mfg. Co.
United States Rubber Co.

Paint, Preservative

Detroit Graphite Co.
Dixon Crucible Co.
Paraffine Companies, Inc.
Standard Oil Co.

Paper, Building, Insulating and Asbestos

Paraffine Companies, Inc.

Pebbles

Atkins, Kroll & Co.
Hardinge Conical Mill Co.
Jasper Stone Co.

Perforated Metals

Allis-Chalmers Mfg. Co.
Galigher Machinery Co.
Harrington & King Perforating Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.

Pipe Covering

Paraffine Companies, Inc.

Pipe Fittings

Diamond Rubber Co.
Galigher Machinery Co.
Garrett & Co., W. T.
Goodrich Rubber Co., B. F.
Lunkenheimer Co., The
Merrill Company
Norwalk Iron Works
Pacific Pipe Co.
Pacific Tank & Pipe Co.
Powell Co., Wm.
Sacramento Pipe Works

Pipe, Cast Iron

American Cast Iron Pipe Co.
Buttress & McClellan
Pacific Pipe Co.

Pipe, Riveted

American Spiral Pipe Works
Sacramento Pipe Works

Pipe, Standard Wrought

National Tube Co.
Pacific Pipe Co.

Pipe, Wood

National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

Placer Mining Machinery

Aldrich Pump Co.
American Spiral Pipe Works
Collins & Webb, Inc.
Harrington & King Perforating Co.
Morse Bros. Machy. & Sup. Co.
National Milling & Refining Co.
New York Engineering Co.
Overstrom Mfg. Co.
Senn Concentrator Co.
Union Construction Co.
Yuba Mfg. Co.

Pneumatic Tools

Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Prospecting Supplies

Braun Corporation, The
Braun-Knecht-Heimann Co.
Dobbins Core Drill Co.
Longyear Co., E. J.
Mine & Smelter Supply Co.
New York Engineering Co.
Rix Compressed Air & Drill Co.
Union Construction Co.

Pulleys, Magnetic

Dings Magnetic Separator Co.

Pulleys, Shafting and Hangers (see "Transmission Machinery")

Pumps, Air Lift

Aldrich Pump Co.
Buttress & McClellan
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Pumps, Centrifugal

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
American Well Works
Buttress & McClellan
Cameron Steam Pump Wks., A. S.
Collins & Webb, Inc.
Fairbanks, Morse & Co.
Frenier & Sons
Galigher Machinery Co.
Garrett & Co., W. T.
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Jackson Iron Works, Byron
Krogh Pump & Machinery Co.
Mine & Smelter Supply Co.
Meese & Gottfried Co.
Morris Machine Works
Morse Bros. Machy. & Sup. Co.
Oliver Continuous Filter Co.
Pacific Pipe Co.
Pelton Water Wheel Co.
Rix Compressed Air & Drill Co.
Rosenberg & Co.
Simpson Co., A. H.
Western Machinery Co.
Worthington Pump & Mach. Corp.
Yuba Mfg. Co.

Pumps, Reciprocating

Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Cameron Steam Pump Wks., A. S.
Galigher Machinery Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Rix Compressed Air & Drill Co.
Rosenberg & Co.
Worthington Pump & Mach. Corp.

Quicksilver

Atkins, Kroll & Co.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Bullard, E. D.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

Railway Supplies and Equipment

Atlas Car & Mfg. Co.
Diamond Rubber Co., Inc.
Hickok & Hickok

Roller Bearings

Hyatt Roller Bearing Co.

Rolls, Crushing

Atlas Car & Mfg. Co.
Bacon, Inc., Earle C.
Chalmers & Williams
Collins & Webb, Inc.
Colorado Iron Works Co.
Denver Engineering Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Roofing

American Sheet & Tin Plate Co.
Kansas City Structural Steel Co.
Paraffine Companies, Inc.
Standard Oil Co.

Rope, Manila

Waterbury Co.

Rope, Wire

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Buttress & McClellan
Denver Engineering Works Co.
Dodge Sales & Eng. Co.
Galigher Machinery Co.
Leschen & Sons Rope Co., A.
Meese & Gottfried Co.
Roebing's Sons Co., John A.
Simpson Co., A. H.
Waterbury Co.

Rubber Boots and Shoes

Goodrich Rubber Co., B. F.
United States Rubber Co.

Safety Appliances

Bullard, E. D.
Siebe, Gorman Co., Ltd.

Samplers

Braun Corporation, The
Braun-Knecht-Heimann Co.
Colorado Iron Works Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.

Saw Mill Machinery

Meese & Gottfried Co.

Screens

Allis-Chalmers Mfg. Co.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Chalmers & Williams
Colorado Iron Works Co.
Collins & Webb, Inc.
Denver Engineering Works Co.
Galigher Machinery Co.
Harrington & King Perforating Co.
James Ore Concentrator Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.
Rosenberg & Co.
Stimpson Equipment Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Separators

Dings Magnetic Separator Co.

Separators, Dry

National Milling & Refining Co.

Shafting (see "Transmission Machinery")

Sheet-Steel

American Sheet & Tin Plate Co.
Kansas City Structural Steel Co.

Shoes and Dies

Bethlehem Shipbuilding Corp., Ltd.
Denver Engineering Works Co.
Hickok & Hickok
Worthington Pump & Mach. Corp.

Shovels, Electric and Steam

Leschen & Sons Rope Co., A.

Silex

Atkins, Kroll & Co.
Denver Fire Clay Co.
Hardinge Conical Mill Co.
Jasper Stone Co.

Sintering and Agglomerating Machinery

Worthington Pump & Mach. Corp.

Smelters and Refiners

American Zinc, Lead & Smelt. Co.
Empire Zinc Co.
International Smelting Co.
U. S. Smelting, Ref. & Min. Co.
Wildberg Bros.

Smelting Machinery

Allis-Chalmers Mfg. Co.
Collins & Webb, Inc.
Colorado Iron Works Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Sup. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Solder

Finn Metal Works, John

Springs

American Spiral Pipe Works
American Steel & Wire Co.
Cary Spring Works

Steel, Drill

Buttress & McClellan
Collins & Webb, Inc.
Denver Rock Drill Mfg. Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
International High Speed Steel Co.
Simpson Co., A. H.
Sullivan Machinery Co.

Steel, Structural

Kansas City Structural Steel Co.

Steel, Tool

Galigher Machinery Co.
International Highspeed Steel Co.

Tanks, Steel

Buttress & McClellan
Denver Eng. Works Co.
Galigher Machinery Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
Rosenberg & Co.
Simpson Co., A. H.

Tanks, Wood

Buttress & McClellan
Denver Eng. Works Co.
Galigher Machinery Co.
Morse Bros. Machy. & Sup. Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

Tapes, Measuring

Galigher Machinery Co.
Lufkin Rule Co.

Thickeners, Pulp

Buttress & McClellan
Collins & Webb, Inc.
Colorado Iron Works Co.
Dorr Co., The
National Tank & Pipe Co.
Oliver Continuous Filter Co.
Pacific Tank & Pipe Co.

Tires, Auto and Truck

Goodrich Rubber Co., B. F.

Tractors

Yuba Mfg. Co.

Tramways, Aerial

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Morse Bros. Machy. & Sup. Co.
Simpson Co., A. H.

Transits

Ainsworth & Sons, Wm.
Braun Corporation, The
Braun-Knecht-Heimann Co.

Transmission Machinery

Allis-Chalmers Mfg. Co.
American Pulley Co.
Camden Forge Co.
Dodge Sales & Eng. Co.
General Electric Co.
Johnson Gear Works
Meese & Gottfried Co.
Pratt-Gilbert Co.
Rosenberg & Co.
Wellman-Seaver-Morgan Co.

Trucks, Motor (see "Motor Trucks")

Tube-Mills (see "Mills")

Turbines, Hydraulic

Allis-Chalmers Mfg. Co.
Pelton Water Wheel Co.
Smith Co., S. Morgan

Turbines, Steam

Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Valves

Crane Co.
Lunkenheimer Co., The
Merrill Co., The
Norwalk Iron Works
Powell Co., Wm.

Water Wheels, Impulse

Harron, Rickard & McConne
Morse Bros. Machy. & Sup. Co.
Pelton Water Wheel Co.
Simpson Co., A. H.
Smith Co., S. Morgan
Wellman-Seaver-Morgan Co.

Well Drilling Machy. and Supplies

American Well Works
Union Construction Co.

Wheels, Car

Atlas Car & Mfg. Co.
Galigher Machinery Co.
Hickok & Hickok

Whistles

Lunkenheimer Co., The

Wire

American Steel & Wire Co.
Broderick & Bascom Rope Co.
Diamond Rubber Co.
General Electric Co.
Goodrich Rubber Co., B. F.
Meese & Gottfried Co.
Roebing's Sons Co., John A.
Simpson Co., A. H.
United States Rubber Co.

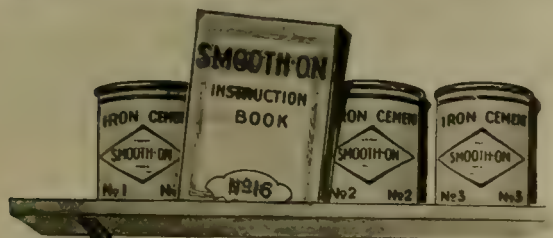
Zinc Boxes

Buttress & McClellan
Colorado Iron Works Co.
Mine & Smelter Supply Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.
Traylor Eng. & Mfg. Co.

Zinc Dust and Shavings

American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Buttress & McClellan
Denver Fire Clay Co.
Finn Metal Works, John
Merrill Co., The
Mine & Smelter Supply Co.
Pacific Tank & Pipe Co.
U. S. Smelting, Ref. & Min. Co.

SMOOTH-ON IRON CEMENTS



Keep Them All on Your Supply Shelf

With a SMOOTH-ON Instruction Book and a can of No. 1 and No. 3 SMOOTH-ON Iron Cements on your supply shelf you are ready for any emergency.

There are 4 different kinds of SMOOTH-ON for engineers' use, each exactly right for its special purpose. For instance, SMOOTH-ON Iron Cement No. 1 is a *quick-hardening* iron cement in powder form for stopping leaks of water, steam, gas or oil; SMOOTH-ON Iron Cement No. 2 is similar to No. 1 but is *slow-hardening and semi-hydraulic*. SMOOTH-ON Elastic Cement No. 3 is especially good for making tight screwthread joints and for coating gaskets. No. 7 is for water-, oil-, dust-, and wear-proofing concrete.

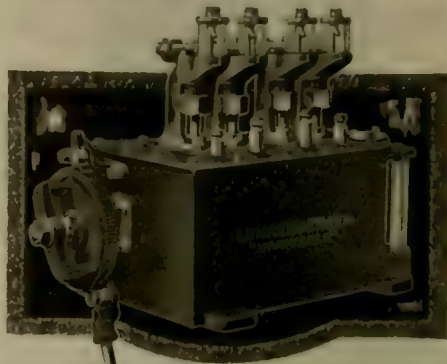
Order SMOOTH-ON from your supply house. Write direct to the SMOOTH-ON MFG. CO., for the Instruction Book—it's free.

SMOOTH-ON MANUFACTURING CO.
ESTABLISHED 1898
570-574 COMMUNIPAW AVE., JERSEY CITY, N.J. U.S.A.

Chicago Office:
221 N. Jefferson St.

San Francisco office:
56 Sacramento St.

Dependable lubrication

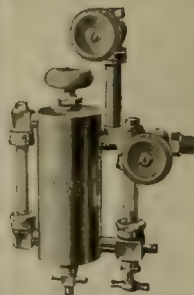


LUNKENHEIMER CYLINDER LUBRICATORS



Are positive in operation, delivering the quantity of oil for which the feed is set—uniformly and without fail.

Their installation on the units of a power plant is assurance of economy both in operation and oil consumption.



The variety of types made includes Mechanical, Hydrostatic and Gravity feed, and the Hand Oil Pump is highly satisfactory as an auxiliary when starting or for emergency.

Specify Lunkenheim and insist on their installation. Leading dealers sell them.

Booklets No. 526-CD and 572-CD are ready references on Lubricator Equipment. Copies of both at your request.



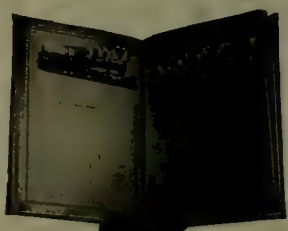
THE LUNKENHEIMER CO.
"QUALITY"

Largest Manufacturers of
High Grade Engineering Specialties
in the World

New York CINCINNATI London
Chicago Boston

PORTER LOCOMOTIVES

Light
and
Heavy

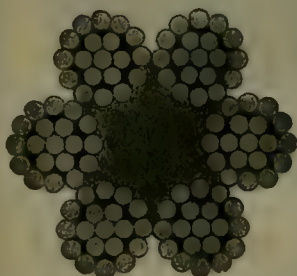


Steam
Fireless
Compressed
Air

Write for our new catalogue. If you use locomotives it will be invaluable to you.

H.K. PORTER CO., PITTSBURGH, PA.

ROEBLING WIRE ROPE



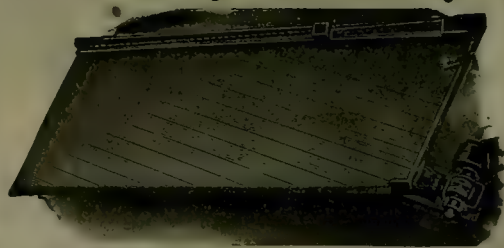
the efficient wire rope for mine hoists and haulage and all other purposes for which wire rope is used.

Complete line of
Wire Rope Fittings.

**John A. Roebling's
Sons Company**
of California

S n Francisco Los Angeles
Seattle Portland, Ore.

Deister-Overstrom Diagonal Deck Concentrating Table



A higher extraction of values. Minimum percentage of middlings. A higher grade concentrate. Greater capacity.
WRITE FOR ILLUSTRATED BOOKLET.

The Deister CONCENTRATOR Company
Office, Factory and Test Plant: FORT WAYNE, IND.

APOLLO-KEYSTONE

COPPER STEEL
Galvanized

Sheets



Highest in quality and rust resistance. Unequaled for Culverts, Flumes, Tanks, Roofing, Siding, Spouting, and all exposed sheet metal work.

We manufacture Sheet and Tin Mill Products of every description—Black and Galvanized Sheets, Corrugated and Formed Products, Roofing Tin Plates, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.

Pacific Coast Reps: U. S. Steel Products Co., San Francisco, Los Angeles, Portland, Gen.

DREDGES FOR GOLD AND TIN

UNION CONSTRUCTION CO.

604 Mission St., San Francisco, Cal.

Neill Jigs

Union Churn Drills

YUBA

GOLD DREDGES

Yuba Ball Tread Tractors Yuba Centrifugal Pumps

YUBA MANUFACTURING COMPANY

WORKS: Marysville, Cal. SALES OFFICE: 433 California St., San Francisco, Cal.

FLOTATION

PINE TAR OIL
PURE PINE OIL

OIL

HARDWOOD CREOSOTE
COAL TAR CREOSOTE

Get Our Prices

Samples Gratis

UNITED NAVAL STORES CO., NEW YORK

ATKINS, KROLL & CO., San Francisco

IMPORT MERCHANTS

DANISH FLINT PEBBLES, SILEX LINING, CYANIDE
QUICKSILVER, MINING CANDLES, FIREBRICK,
BORTS AND CARBONS, BLACKSMITH COAL, COKE
IMPORTED FUSE, SCHEELITE CONCENTRATES, 70%
SUPERIOR QUALITY ZINC DUST.

STOCKS CARRIED

SEND FOR CATALOG

A-9 OF BALANCES

BX-9 OF ENGINEERING INSTRUMENTS

WM. AINSWORTH
& SONS

THE PRECISION FACTORY

DENVER, COLO.
U.S.A.

The Empire Zinc Company Buys Zinc Ores

Address our Offices:

160 Front St., New York, N. Y.

703 Symes Bldg., Denver, Colo.

Or write to

H. L. WILLIAMS,
605 KEARNS BLDG.,
SALT LAKE CITY, UTAH

UNIVERSAL CYANIDING MACHINE

TRENT

AGITATORS
THICKENERS
REPLACERS

GOODWIN M. TRENT

317 Sharon Bldg.,

San Francisco, Calif.

WILDBERG BROS.,

Smelters, Refiners and Purchasers of

Gold and Silver Ores, Gold Dust, Bullion and
Native Platinum

Producers of Proof Gold and Silver for Assayers

OFFICE 416-419 PACIFIC BLDG.

SAN FRANCISCO

AMERICAN ZINC, LEAD & SMELTING COMPANY

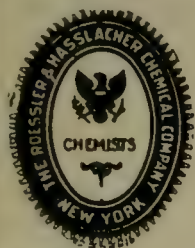
Purchasers of
ZINC AND LEAD ORES

Address: 1012 Pierce Building, St. Louis, Mo.

EXPLORATION DEPARTMENT FOR THE PURCHASE OF
METAL MINES AND METAL MINING COMPANIES

55 Congress St., Boston, Mass.

The Roessler & Hasslacher Chemical Company



100 William Street, New York
Works: Perth Amboy, N. J.

Cyanide of Sodium 96-98%

Cyanogen 51-52%

"Cyanegg"

Sodium Cyanide 96-98% in egg form,
each egg weighing 1 ounce.

Cyanogen 51-52%

United States Smelting, Refining & Mining Company

55 CONGRESS STREET, BOSTON, U. S. A.

BUYERS OF

Gold, Silver, Lead, Copper and Zinc Ores, Matte and
Furnace Products.

REFINERS OF

Blister Copper and Lead Bullion.

PRODUCERS AND SELLERS OF

Gold, Silver, Lead, Copper, Spelter, Zinc Dust, Arsenic,
Insecticides, Fungicides, Cadmium, and Selenium.

OPERATING OFFICES:

912 Newhouse Building, Salt Lake City, Utah; Ken-
nett, Cal.; Goldroad, Ariz.; Baxter Springs, Kansas;
120 Broadway, New York; Pachuca (Real del Monte
Co.), Mexico.

SELLING OFFICES: 120 BROADWAY, NEW YORK

UNITED STATES METALS REFINING COMPANY,

Copper Smelter and Refinery, Chrome, N. J.
Importers of Copper Ores, Mattes and Bullion,
120 Broadway, New York

United States Smelting R. & M. Exploration Co.

For examination and purchase of Metal Mines, 55 Congress St.,
Boston, Mass. District Offices, 120 Broadway, N. Y.; 1504 Hobart
Bldg., San Francisco, Cal.; Newhouse Bldg., Salt Lake City, Utah.

American Smelters Securities Co. (Selby Smelting Works)

Buyers of

GOLD and SILVER BULLION
ORES, CONCENTRATES, ETC.

Consign all shipments to

AMERICAN SMELTERS SECURITIES CO.
SELBY, CAL.

Address correspondence to

MERCHANTS EXCHANGE BLDG., SAN FRANCISCO

INTERNATIONAL SMELTING CO.

New York Office: 42 Broadway

Purchasers of

Gold, Silver, Copper, and
Lead Ores

SMELTING WORKS: INTERNATIONAL, UTAH, and MIAMI ARIZ.

REFINERIES:

International Lead Refining Company, East Chicago, Indiana
Bariton Copper Works, Perth Amboy, N. J.

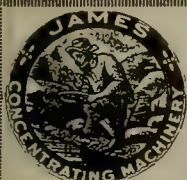
ORE PURCHASING DEPARTMENT:

618 Kearns Building, Salt Lake City, Utah

GENERAL BRIQUETTING COMPANY Consulting Engineers

25 Broad Street, New York

Specialists in the Briquetting of Ores,
Flotation Concentrates, Coals, Etc.



Jigs, Screens, Sand and Slime
Tables, Classifiers, Automatic
Ore Feeders, Etc.

Manufactured by
JAMES ORE CONCENTRATOR CO.
35 Runyon Street Newark, N. J.

GRUBNAU BRYANT & GRUBNAU

BUYERS OF

Zinc Carbonate Ores

OFFICES and WORKS:

Waldo, New Mexico

ALPHABETICAL INDEX TO ADVERTISERS

- Dash Indicates - Every Other Week or Monthly Advertisement -

Page		Page		Page	
Ainworth & Sons, Wm., Denver.....	64	Galigher Machy. Co., Salt Lake City, Utah.....	47	New York Engineering Co., New York.....	8
Aldrich Pump Co., Allentown, Pa.....	55	Gandy Belting Co., Baltimore, Md.....	57	Nordberg Mfg. Co., Milwaukee, Wis.....	22
Allis-Chalmers Mfg. Co., Milwaukee, Wis.....	6	Gardner Governor Co., Quincy, Ill.....	—	Norwalk Iron Works Co., So. Norwalk, Conn.....	—
American Cast Iron Pipe Co., Birmingham, Ala.....	39	Garford Motor Truck Co., Lima, Ohio.....	—	Novo Engine Co., Lansing, Mich.....	—
American Pulley Co., Philadelphia, Pa.....	—	Garratt & Co., W. T., San Francisco.....	44	Oliver Continuous Filter Co., San Francisco.....	24
American Sheet & Tin Plate Co., Pittsburgh.....	64	General Briquetting Co., New York.....	65	Opportunity Pages.....	30-40
American Smelters Securities Co., San Francisco.....	65	General Electric Co., Schenectady, N. Y.....	30	Ottumwa Iron Works, Ottumwa, Iowa.....	—
American Spiral Pipe Works, Chicago.....	60	General Engineering Co., Salt Lake City, Utah.....	32	Overstrom Manufacturing Co., San Francisco.....	—
American Steel & Wire Co., Chicago.....	61	General Naval Stores, New York.....	48	Oxweld Acetylene Co., New York.....	—
American Well Works, Aurora, Ill.....	—	Giant Powder Co., Wilmington, Del.....	43	Pacific Pipe Co., San Francisco.....	39
American Zinc, Lead & Smelting Co., St. Louis.....	65	Gibson, W. W., San Francisco.....	—	Pacific Tank & Pipe Co., San Francisco.....	28
Assayers, Chemists and Ore Testing Works.....	56	Goodrich Rubber Co., B. F., Akron, Ohio.....	—	Paraffine Companies, Inc., San Francisco.....	—
Atkins, Kroll & Co., San Francisco.....	64	Goodyear Tire & Rubber Co., Akron, Ohio.....	31	Pelton Water Wheel Co., San Francisco.....	45
Atlas Car & Mfg. Co., Cleveland, Ohio.....	48	Grubnau, Bryant & Grubnau, Waldo, N. M.....	65	Pensacola Tar & Turpentine Co., Gull Point, Fla.....	48
Bacon, Inc., Earle C., New York.....	48	Hardinge Conical Mill Co., New York.....	—	Pioneer Rubber Mills, San Francisco.....	—
Barrett Co., The, New York.....	40	Harrington & King Perforating Co., Chicago.....	59	Porter Co., H. K., Pittsburgh, Pa.....	64
Bartley Crucible Co., Jonathan, Trenton, N. J.....	7	Hendrie & Bolthoff Mfg. & Supply Co., Denver.....	4	Positions Available.....	38
Bethlehem Shipbuilding Corp., San Francisco.....	—	Hendy Iron Works, Joshua, San Francisco.....	—	Positions Wanted.....	37
Blake, Moffitt & Towne, San Francisco.....	36	Hercules Powder Co., Wilmington, Del.....	—	Powell Co., Wm., Cincinnati, Ohio.....	41
Bonnot Co., Canton, Ohio.....	—	Herman, John, Los Angeles, Cal.....	40	Prescott Co., The, Menominee, Mich.....	—
Books, Technical.....	34-42-45-46	Hickok & Hickok, San Francisco.....	—	Professional Directory.....	50-54
Braun Corporation, The, Los Angeles, Cal.....	57	Hyatt Roller Bearing Co., New York.....	—	Reardon, P. H., San Francisco.....	66
Braun-Knecht-Heimann Co., San Francisco.....	57	Imperial Munitions Board, Toronto, Canada.....	38	Rebuild Machinery Co., Colorado Springs, Colo.....	39
Broderick & Bascom Rope Co., St. Louis.....	59	Ingersoll-Rand Co., New York.....	12-13	Redwood Mfrs. Co., San Francisco.....	—
Bullard, E. D., San Francisco.....	55	International Smelting Co., New York.....	65	Rix Compressed Air & Drill Co., San Francisco.....	—
Business Men's Clearing House, Denver.....	38	Jackson Compressor Co., Denver.....	43	Roebbling's Sons Co., John A., Trenton, N. J.....	64
Butchart, W. A., Denver, Colo.....	36	Jackson Iron Works, Byron, San Francisco.....	47	Roessler & Hasslacher Chemical Co., New York.....	65
Butters & Co., Ltd., Chas., New York.....	—	James Ore Concentrator Co., Newark, N. J.....	65	Rosenberg & Co., Los Angeles, Cal.....	—
Buttress & McClellan, Los Angeles, Cal.....	—	Jardine Machinery Co., San Francisco.....	37	Sacramento Pipe Works, Sacramento, Cal.....	48
Buyers' Guide.....	58-60-62	Jasper Stone Co., Sioux City, Iowa.....	59	San Francisco Plating Works, San Francisco.....	39
California Cap Co., Oakland, Cal.....	—	Johnson Gear Works, San Francisco.....	—	Senn Concentrator Co., San Francisco.....	15
Camden Forge Co., Camden, N. J.....	—	Jordan Co., O. F., East Chicago, Ind.....	18	Siebe, Gorman & Co., Ltd., Chicago, Ill.....	—
Cameron Steam Pump Works, A. S., New York.....	26	Justrite Mfg. Co., Chicago.....	43	Simpson Co., A. H., San Francisco.....	35
Car-Dumper & Equipment Co., Chicago.....	45	Kansas City Structural Steel Co., Kansas City, Mo.....	61	Smith Co., S. Morgan, York, Pa.....	41
Cary Spring Works, New York.....	—	Kaufman Co., H. C., Los Angeles, Cal.....	41	Smooth-On Mfg. Co., Jersey City, N. J.....	63
Cement-Gun Co., Allentown, Pa.....	49	Krogh Pump & Mach. Co., San Francisco.....	—	Southwestern Engineering Co., Los Angeles.....	—
Chalmers & Williams, Chicago Heights, Ill.....	—	Lanc Mill & Machy. Co., Los Angeles, Cal.....	48	Standard Oil Co., San Francisco.....	—
Chicago Pneumatic Tool Co., Chicago.....	23	Leschen & Sons Rope Co., A., St. Louis.....	48	Stearns-Rogers Mfg. Co., Denver, Colo.....	36
Cleveland Rock Drill Co., Cleveland, Ohio.....	49	Lidgerwood Mfg. Co., New York.....	—	Stimpson Equipment Co., Salt Lake City.....	2
Cochise Machine Co., Los Angeles, Cal.....	—	Llewellyn Iron Works, Los Angeles.....	—	Sullivan Machinery Co., Chicago.....	3-39
Couins & Wevo, Inc., Los Angeles, Cal.....	19	Longyear Co., E. J., Minneapolis, Minn.....	55	Thompson Balance Co., Denver.....	39
Colorado Iron Works, Denver.....	67	Los Angeles Foundry Co., Los Angeles, Cal.....	59	Traylor Eng. & Mfg. Co., Allentown, Pa.....	9
Crane Co., Chicago, Ill.....	—	Ludlow-Saylor Wire Co., St. Louis, Mo.....	5	Trent, Goodwin M., San Francisco.....	64
Deister Machine Co., Port Wayne, Ind.....	68	Lulkin Rule Co., Saginaw, Mich.....	48	Union Construction Co., San Francisco.....	33-64
Deister Concentrator Co., Port Wayne, Ind.....	64	Lunkenheimer Co., The, Cincinnati, Ohio.....	63	United Filtrics Corp., Salt Lake City, Utah.....	37
Denver Engineering Works Co., Denver.....	61	Main Belting Co., Philadelphia, Pa.....	27	United Naval Stores, New York.....	64
Denver Fire Clay Co., Denver.....	17	Marathon Mill & Machine Works, Chicago.....	48	U. S. Iron Works, Seattle, Wash.....	—
Denver Rock Drill Mfg. Co., Denver.....	61	Marchant Calculating Machine Co., Emeryville, Cal.....	—	U. S. Rubber Co., New York.....	—
Denver Quartz Mill & Crusher Co., Denver.....	—	Meese & Gottfried Co., San Francisco.....	68	U. S. Smelting, Refining & Mining Co., Boston.....	65
Detroit Graphite Co., Detroit, Mich.....	—	Merchants & Mfrs. Exchange, New York.....	—	Waterbury Co., New York.....	67
Dewey, Strong & Townsend, San Francisco.....	48	Merrill Co., San Francisco.....	35	Wellman-Lewis Co., Los Angeles, Cal.....	46
Diamond Rubber Co., Akron, Ohio.....	—	Mine Equipment & Supply Co., Denver, Colo.....	—	Wellman-Seaver-Morgan Co., Cleveland, Ohio.....	—
Diggs Magnetic Separator Co., Milwaukee, Wis.....	21	Mine & Smelter Supply Co., New York.....	Front Cover	Western Machinery Co., Los Angeles, Cal.....	44
Dixon Crucible Co., Joseph, Jersey City, N. J.....	21	Monroe Calculating Machine Co., New York.....	—	Western Wood Pipe Pulpity Bureau, Seattle, Wash.....	10-11
Dobbins Core Drill Co., New York.....	14	Morris Machine Works, Baldwinville, N. Y.....	16	Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.....	—
Dodge Sales & Eng. Co., Mishawaka, Ind.....	20	Morse Bros. Machy. & Supply Co., Denver.....	38-39-40	White Co., The, Cleveland, Ohio.....	—
Dorr Company, The, Denver.....	40	Mutual Truck Co., Sullivan, Ind.....	—	Wildberg Bros., San Francisco.....	64
Drake Lock-Nut Co., San Francisco.....	39	National Milling & Refining Co., Canton, Ohio.....	—	Wolf Safety Lamp Co., Brooklyn, N. Y.....	—
Elmer, H. N., Chicago.....	—	National Tank & Pipe Co., Portland, Ore.....	48	Worthington Pump & Machy. Corp., New York.....	—
Empire Zinc Co., Denver, Colo.....	64	National Tube Co., Pittsburgh, Pa.....	14	Young & Tyler, Los Angeles, Cal.....	46
English Tool & Supply Co., Kansas City.....	—	Nevada Eng. & Supply Co., Reno, Nev.....	—	Yuba Manufacturing Co., San Francisco.....	64
Fairbanks, Morse & Co., Chicago.....	—			Zelnicker Supply Co., Walter A., St. Louis.....	—
Fate-Roth-Heath Mfg. Co., Plymouth, Ohio.....	—				
Filter Fabrics Co., Salt Lake City, Utah.....	—				
Finn Metal Works, John, San Francisco.....	39				
Flexible Steel Lacing Co., Chicago, Ill.....	43				
Florida Wood Products Co., Jacksonville, Fla.....	40				
Frenier & Son, Rutland, Vermont.....	48				

SPIRAL CONVEYORS

ANY
SIZE



ANY
STYLE

MANUFACTURED IN SAN FRANCISCO
IN STOCK FOR IMMEDIATE DELIVERY

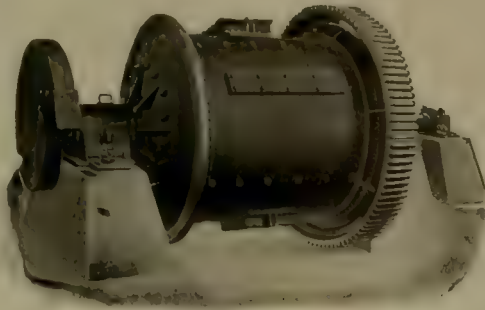
Compressed Air and General Machinery,
Mine, Mill and Contractors Supplies

P. H. REARDON, 57 FIRST ST., SAN FRANCISCO

This Convertible Discharge Ball Mill

is a distinctly advantageous buy.

Discharge through a grating, or discharge directly through the trunnion may eventually prove best for your particular conditions. Which it will be can rarely be positively foretold. Why, therefore, tie your hands with a mill, inflexible in this respect, when the



6-ft. x 6-ft. Colorado Convertible Discharge Ball Mill.

Colorado Convertible Discharge Ball Mill

if installed, may readily be changed from one system of discharge to the other.

In addition to this advantage, our ball mills are of massive, thorough construction, and embody the results of an extensive experience in ball mill building.

Send for Pamphlet 31

Colorado Iron Works Company

New York Office, 30 Church St.

Denver, Colorado

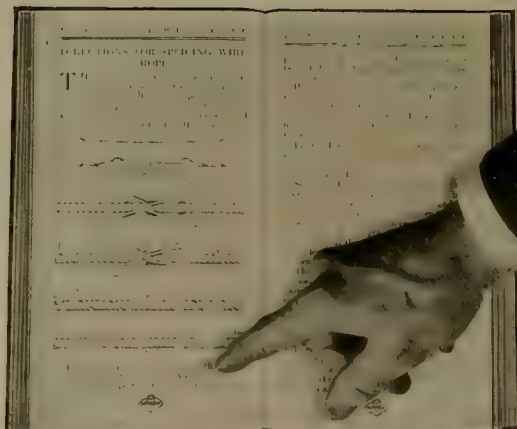
Waterbury Wire Rope

Splicing a wire rope, rigging a thimble, sheave and drum tables, comparative strengths, factors of safety, construction and lays—anything else you might want to look up about wire rope, is there in quick, findable form in the Waterbury Rope Handbook—a 220 page cloth bound manual with more rope “dope” in it than can be found between two covers anywhere else—and a copy will be sent free at your request.

The Waterbury Company has only one standard for the rope it makes—quality. Grade for grade, Waterbury Wire Rope like every other Waterbury rope, has no superior.

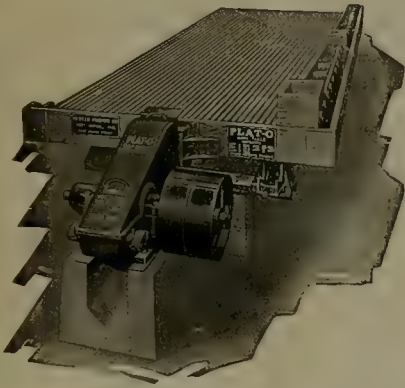
WATERBURY COMPANY **63 PARK ROW NEW YORK**

CHICAGO—1315-1321 West Congress St. DALLAS, TEX.—A. T. Powell & Co.
SAN FRANCISCO—151-161 Main St. NEW ORLEANS—1018 Maison Blanche Bdg.



PLAT-O TABLE

NOTE *the* SIMPLICITY *and* EXCELLENCE

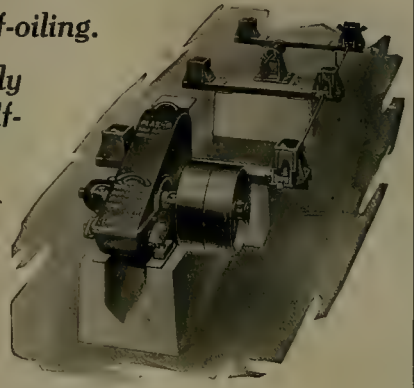


Deck Bearings are self-oiling.

Headmotion is entirely enclosed and self-oiling.

The main channel frame is no longer used.

Write for Full Particulars of the
PLAT-O TABLE



MANUFACTURED AND SOLD EXCLUSIVELY BY

DEISTER MACHINE COMPANY

East Wayne Street

MANUFACTURERS OF THE WELL KNOWN

Fort Wayne, Ind., U. S. A.

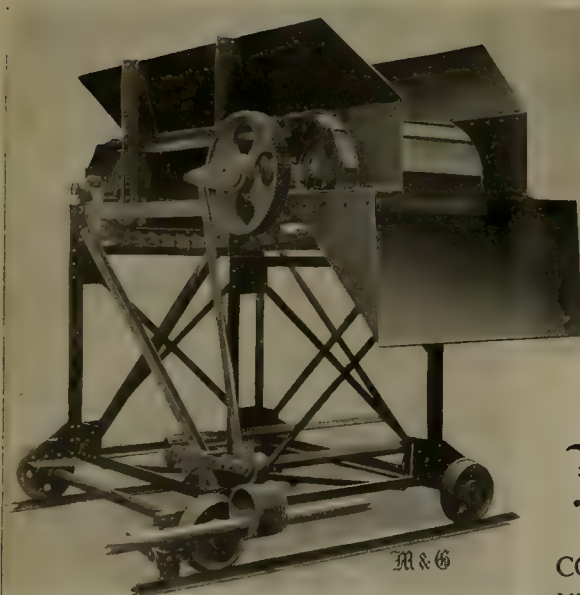
DEISTER SIMPLEX TABLES and CONE BAFFLE CLASSIFIERS

E. DEISTER, Pres. and Gen. Mgr.

W. F. DEISTER, Vice Pres.

E. G. HOFFMAN, Secy. and Treas.

M&G FEEDING DEVICES ARE MADE FOR EVERY REQUIREMENT



Simple hand-operated feeding gates of a dozen different designs.

Automatic air-controlled reciprocating rock and ore feeders of any capacity.

Heavy apron feeders, continuous or intermittent, stationary or traveling.

Let us Figure on Your Requirements
in This Line



Meece & Gottfried Company
ENGINEERS AND MANUFACTURERS

CONVEYING, ELEVATING, SCREENING AND
MECHANICAL POWER TRANSMITTING MACHINERY

M&G Traveling or (Portable) Ratchet Apron Feeder. Suitable for feeding ore and similar material to pan or belt conveyor.

SAN FRANCISCO
660 Mission St.

LOS ANGELES
400 E. 3rd St., Cor. San Pedro

SEATTLE
558 First Ave. So.

PORTLAND
67 Front Street

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JANUARY 10, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page		Page
EDITORIAL		PANAMA MUSEUM	
NOTES	33	By T. T. Read	40
THE INDUSTRIAL CONFERENCE	34	Mineral specimens desired for collection at 'Colegio de La Salle', Panama City.	
Abstract of text as published on December 28. It recognizes the human element in the industrial problem. Economic interdependence. The concept of leadership must replace that of master-ship. Establishment of tribunals to adjust disputes. Details of the scheme. A plan that is national, but decentralized.		SIMPLIFIED SPELLING	
PUBLIC OFFICE AND PRIVATE PRACTICE—I....	35	By W. H. Shockley	40
An old controversy revived. The Department of Agriculture in the University of California. Proposal to establish an engineering experiment station, to give gratuitous advice and compete with the University graduates in engineering. What work is now done for the public. The U. S. Bureau of Mines and its investigations. The U. S. Geological Survey, and the reports made by its members abroad.		Mr. Shockley is still unshaken in his advocacy of simplified spelling.	
DISCUSSION		ARTICLES	
SILVER		THE BUNKER HILL ENTERPRISE—II	
By E. P. Crawford	37	By T. A. Rickard	41
Believes price of silver will remain high.		Idaho. A wonderful region. Early history. E. D. Pierce, pioneer miner. First successful prospecting in Coeur d'Alene district. Events preceding discovery of the silver-lead lodes in 1885.	
GOLD AND SILVER AS MONEY		A CONTRIBUTION TO THE STUDY OF FLOTATION—II	
By Roy M. Harrop	37	By H. Livingstone Sulman	47
A proposal for a bi-metallic monetary system.		Further discussion of the physics of flotation. Molecular constitution of solids and liquids. Gravitation and molecular forces. Intrinsic pressure. Surface-energy and surface-tension.	
THE CROWE PROCESS		IMPRISONED UNDERGROUND	
By James S. Colbath	38	By George Huston	53
Mr. Crowe entitled to full credit for applying 'vacuum' process.		Remarkable experience resulting from accident in Gold Hunter mine. Entombed for two weeks.	
FINE GRINDING IN BALL-MILLS		THE COMO CONSOLIDATED MILL	
By Henry Hanson	39	By F. Borzynski	55
Two graphs showing sizing of ball-mill feed and discharge.		Stamp-mill and cyanide plant treating 100 tons of gold-silver ore at Como, Lyon county, Nevada. Flow-sheet and description.	
MINE SURVEYING		NOTES	
By A. T. Parsons	39	GRAPHITE IN MADAGASCAR.	52
The use of 300-ft. and 500-ft. tapes in surveying.		DEPARTMENTS	
THE BURMA MINE		REVIEW OF MINING	57
By W. Shellshear	39	THE MINING SUMMARY	65
T. E. Mitchell served as resident manager.		PERSONAL	66
		THE METAL MARKET	67
		EASTERN METAL MARKET	68
		BOOK REVIEWS	69
		INDUSTRIAL PROGRESS	70

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.

The Copper Mountain in 1899



Two Wilfley Tables helped start the Utah Copper Co. to success—

ONCE more we say, "the story of the Wilfley is the history of concentration."

In 1899, D. C. Jackling made the first definite step toward the present mighty success of the Utah Copper Co. when he equipped an experimental mill at Bingham with five stamps and TWO WILFLEY TABLES.

Many changes have since been wrought in the mine and in the table, but the same reasons which caused Mr. Jackling to pick the WILFLEY and continue to use it hold good today.

The WILFLEY is known the world over for greatest capacity, highest efficiency, lowest operating cost.

A description of all models of Wilfley Tables and their most modern improvements will be sent upon request.



The Mine and Smelter Supply Company

DENVER • SALT LAKE CITY • EL PASO
New York Office: 42 B'way.

Wilfley Representatives:

Pacific Coast—Harron, Rickard & McCone, San Francisco
Alabama and North Carolina—McClary, Jemison M'ch'y Co., Birmingham
West Coast South America—Gaston, Williams & Wigmore
Australia—F. H. Jackson, Sydney
France, Spain, Italy—L. & E. Frenkel, Paris

PATENTED



PRODUCTION of gold and silver in this country decreased in 1919, according to the preliminary figures issued by the U. S. Geological Survey and the Mint. The output of gold was \$10,157,900 less than in 1918, but California retains the lead, with 840,758 ounces; Colorado is second, and Alaska is third. The output of silver was 12,524,943 ounces less. Montana is first with 14,940,527 ounces; Utah is second, and Nevada is third. These statistics confirm our anticipations.

SEVERAL letters have come to us, apropos of an editorial paragraph in our issue of December 27, asking whether the premium on gold in London is being paid by the British government or by manufacturers. The fact is, of course, that the lifting by the Government of its embargo on the free sale of gold has given play to the force of an increasing demand from those needing the metal in art and industry. A recent letter states that the premium has risen 25%, much to the benefit of the South African, Australian, and Indian gold mines, all of which, naturally, sell their gold in London.

WE are informed that Mr. Van. H. Manning, Director of the U. S. Bureau of Mines, has made an arrangement with the Governor of Colorado whereby \$10,000 will be spent under the direction of the Bureau in making investigations into the oil-shale industry of Colorado. This investigation is to be placed in charge of Mr. Martin J. Gavin, refinery engineer of the Bureau, and will be conducted at Boulder, where a laboratory and office will be furnished by the University of Colorado. The main purpose of the investigation will be to provide the data necessary for the development of a commercial process of retorting oil from the shale and for refining the product.

COPPER sales during 1919 were disappointing, but the outlook today is better than it was at the beginning of last year. Then the surplus was estimated at a billion pounds, but this included the metal in transit to the refineries, so that 650,000,000 pounds would be a fairly correct figure. During the first four months of 1919 the absence of sales and the accumulation of output caused the surplus to rise to nearly a billion pounds, and prospects looked black. They remained cheerless until the last two months of the year, when about 250,000,000 pounds was sold during five weeks, for delivery during the first quarter of this year. Thus deliveries of copper

in 1919 did not equal the output and the real surplus today is larger than it was a year ago. However, the outlook is much improved, for the output from the mines has been decreased considerably, while heavy sales have been made for forward delivery. The demand from abroad is more lively and if only the treaty of peace can be ratified there will be a large expansion of export business.

ACCORDING to information from New York, the American Metal Company has taken over the business of L. Vogelstein & Co., which includes the copper refinery at Chrome, New Jersey. At the recent sale of shares held by the Alien Property Custodian, a large block of stock was purchased by Mr. Ludwig Vogelstein. Other purchasers were the Cerro de Pasco Copper Company, J. Horace Harding, Louis T. Huggin, Charles D. Barney & Company, and others connected with the Cerro de Pasco company. Mr. Vogelstein has been elected a vice-president of the American Metal Co., a fact that suggests how the German element is expelled through one door only to enter through another.

WHETHER the United States will make a large loan to the European nations, or not, is a question to be decided by Congress, not by Mr. Hearst, who beclouds the issue with a lot of mis-statements and exaggerations intended chiefly to excite animosity against Great Britain, where he received a personal slight that has made him vindictive ever since. Apparently international trade is in a bad way, for lack of credits, and Great Britain is taking the lead, in behalf of Europe, in arranging for a large scheme of reconstructive finance, such as will prevent certain parts of the war-devastated countries from utter destitution and industrial collapse. The President and Congress of the United States will do what seems best to them, weighing our own interests first and then those of the less fortunate nations. It is a big subject, and it ought to be studied, not with narrow-minded meanness, but wisely and generously.

ABUDGET is essential to the efficient conduct of any enterprise. A schedule of expenditures, systematically proportioned among the various departments, according to their respective requirements, and with due regard to the total funds available, is necessary. Many households, every efficient business, and nearly every government except that of the United States regulates its

financial affairs by means of some sort of budget. Our method of congressional appropriation is crude, haphazard, unscientific. Only the extraordinary capacity of this country to supply revenue has enabled our income to keep pace with our steadily increasing expenditures. Economists agree that a financial policy so devoid of system as that of our government would speedily bankrupt the soundest railroad corporation. The theory of the budget is to provide the funds needed, but to detect proposed waste and prevent appropriations for non-essentials. Actual experience has proved that the plan operates in practice just as it works out in theory; intelligent people perceive, and fair-minded congressmen concede, this fact. And still we have no real budget, simply because certain alleged 'statesmen' in Congress feel that such a departure would rob them of some of the authority attaching to their position. One solution is to send down to Washington more men of a type different from the average politician. The pompous congressman that nourishes his own personal conceit in constant fear that his individual power may be merged by co-operation with his colleagues is a stumbling-block to efficient government. The acceptance by engineers of their obligation as good citizens to interest themselves in elections will be one step toward the establishment of a national budget.

ON December 12 a jury in the District Court of Southern New York found a verdict of guilty against Harry Lefkovits and R. V. Stuart for use of the mails to defraud, by selling stock in a wild-cat mining company, called the United Magma Mines. This company was hatched during the copper boom in the early part of 1917, but no work was done until after the Government started an investigation preparatory to an action for fraudulent use of the mails. The trial, which began on November 19 last, occupied three weeks. Mr. Louis Lefkovits, brother of the other Lefkovits, was acquitted, and so also was the company itself, the Judge dismissing the case against these two because no definite evidence was available to show that Mr. Louis Lefkovits knew that his brother in New York was selling stock. The locating of the claims in Arizona was done by one brother, while the other did the share-peddling. This brought in \$100,000, of which only \$12,000 went into the company's treasury, the difference presumably being loot. Between April 1917 and January 1919 the only work done on the property was the location work required by law. Mr. Louis Lefkovits obtained permission from the State Corporation Commission of Arizona to sell 200,000 shares at 25 cents, his commission being 5 cents per share. He sold this stock to his brother in New York for 50 cents per share, making the commission 30 cents. Louis claimed that he sold the stock outright to Harry, so that the latter could do as he pleased, but this version of the deal was not accepted by the jury. The property consisted of a string of claims so located that one end of them adjoined the famous mine of the Magma Copper Company in Arizona. The circulars, issued for the pur-

pose of selling stock, were full of the usual iridescent descriptive matter, speaking of a "gigantic orebody" that was to be opened up immediately, if not sooner; they asserted that the wild-cat had "all the earmarks" of a great copper mine, such as the Magma, of course; and talked vaguely but magniloquently about "a policy of vigorous development". It is interesting to note that the promotion stuff was written by Stuart, formerly in the office of George Graham Rice; also that a stricter Blue Sky law is being demanded in New York.

The Industrial Conference

Last week we gave the gist of an important pronouncement by Mr. Hoover on the subject of national economics; since then we have read the report of the Industrial Conference appointed by the President for the purpose of devising suggestions looking toward a method for adjusting industrial disputes. To the 'Sacramento Union' we are indebted for the full text of the report, and we congratulate the editor, Mr. Ben S. Allen, on his enlightened enterprise in giving his readers an opportunity to study such an important document *in extenso*. Of course, it is important; nothing today so deeply concerns the welfare of the United States as some means for checking the succession of strikes that continually interrupt the production of the necessities of life, and undermine the very foundations of democratic institutions. The Conference was convened at Washington on December 1; it issued this preliminary report on December 28 in order to invite discussion before re-assembling on January 12, when it will give respectful consideration to any constructive criticisms that may be forthcoming. The report starts by saying that the purpose of the Conference at this time is to devise machinery for the adjustment of disputes, not to discuss the causes of them. It recognizes the human element in the problem. "Our modern industrial organization, if it is not to become a failure, must yield to the individual a larger satisfaction with life." The complexity of modern industry has tended to kill the spirit of human fellowship; the idea of mutual responsibility has been insufficiently developed. Our human relations must be adjusted to our economic interdependence. The right relationship must be encouraged deliberately. "Not only must the theory that labor is a commodity be abandoned, but the concept of leadership must be substituted for that of mastership." Until the growth of a better relationship between employers and employees, it becomes necessary to devise methods for retarding or preventing disturbance by providing machinery for the adjustment of differences. For this purpose the Conference suggests the establishment of tribunals so organized as to act promptly and impartially. On these tribunals the public must be represented in order to safeguard the larger interest of the community, as well as those of the employers and of the employees. "The plain fact is that the public has long been uneasy about the power of great employers; it is becoming uneasy about the power of great labor organizations. The community must be as-

sured against domination by either." This assurance can be obtained without discriminating against the organizations of either side in the dispute, labor or capital. The right of association on either side must not be denied. Therefore the Conference proposes the creation of a National Industrial Tribunal, which is to consist of nine members appointed by the President; three to represent the employers are to be nominated by the Secretary of Commerce, three to represent the employees will be nominated by the Secretary of Labor, and three will represent the public. This tribunal is to act as a board of appeal; its decisions must be unanimous, but provision is made for publishing majority and minority reports when no agreement is attained. The chief work of pacification will devolve upon regional boards of inquiry and adjustment. For this purpose the country will be divided into twelve regions similar to those established under the Federal Reserve system. In each region the President appoints a chairman, representing the public interest, for a term of three years, with eligibility to re-appointment. In case of an industrial dispute within any region, the chairman will ask each side to select a representative, under rules and regulations laid down for the purpose. The chairman then selects two employers and two employees from two panels previously prepared by the Secretary of Commerce and the Secretary of Labor, respectively, after conference with the employers and employees in the region. The two representatives first selected by the chairman will be entitled to a specified number of peremptory challenges of the names selected by the chairman from the respective panels. Those thus selected, plus the two representatives, with the chairman, will constitute the regional board of adjustment. The appointment of representatives of both sides will constitute an agreement to continue the status of the industry as it existed before the dispute arose, pending an effort at adjustment. Then comes the hearing of evidence by the Board for the purpose of a decision. Such decision must be unanimous; if not, it must be referred to the National Tribunal, unless, by unanimous vote, an umpire is chosen by the Board. If either side refuses to make use of this machinery for settling the trouble, and fails to select a representative, then the chairman is authorized to organize a board of inquiry, by selecting two employers and two employees from the respective panels, together with the representative of either side that may have agreed to submit the dispute to the Board. If both sides fail to choose a representative, the Board will consist of the chairman and the four panel members only. Any decision given by the board of adjustment, by an umpire selected by it, or by the national tribunal will have the full force and effect of a trade agreement. Thus national co-ordination of effort to allay labor disputes is ensured and local bodies are organized for the purpose of adjustment. If adjustment is impeded, there is an assurance of such inquiry and publicity as will bring the force of an enlightened public opinion to bear upon the disputants. The meeting of the contending parties with other men versed in the questions at issue is

bound to assist a settlement; a refusal to submit the dispute to adjustment will instigate an inquiry and create prejudice against the party that is obdurate. The fact that membership on the board of inquiry is available to either party singly will tend further to weaken the position of the recalcitrant side. When both parties join, the Board at once proceeds to an adjustment, and conflict ceases by agreement until a decision is reached. The plan is national in scope, but decentralized. "It is based upon American experience and is designed to meet American conditions," says the report, which is signed by Mr. W. B. Wilson, the Secretary of Labor, as chairman, by Mr. Herbert Hoover, as vice-chairman, and by the 14 members of the Conference. It needs no great analytical insight to detect the intellectual leadership of Mr. Hoover in the findings, and even in the phraseology of the report; through it all runs the same clear common-sense, the recognition of the basic principle of American democracy (an equality of opportunity), and the human sympathy that has made the name of Hoover synonymous with highly organized benefaction.

Public Office and Private Practice—I

An old controversy has been revived lately, namely, should university professors engage in private practice and should Government bureaus conduct experiments and make reports for companies or individuals? For example, the College of Agriculture in the University of California maintains a bureau for scientific research that includes an organization for giving all kinds of professional advice and for affording direct assistance to farmers, not simply in a general way but as regards their specific problems on their own pieces of land. Furthermore, the College maintains an Extension division that gives instruction to farmers on all sorts of definite practical matters much of which is in the nature of personal professional advice. This condition of affairs has prevented the development of a body of agricultural experts in California and has killed the professional practice of the graduates from the College. Suggestions have been made for the organization of an engineering experiment station at the University, to be created primarily by aid of Federal funds, but to be housed by the University. Such a station would, like the agricultural, become an office for giving professional advice gratuitously, thereby competing with consultants now in practice, including the University's own graduates. In normal times many samples of minerals and rocks are sent to the University for assay or analysis, but the senders are informed, both by the Mining department and by the Geology department, that commercial work is not done at the University, and they are referred to established assayers of San Francisco and elsewhere. In the Geology department it has become the custom recently to make qualitative determinations on minerals and general 'field' determinations on specimens of rock, and to advise in a general way concerning the probable demand or market for the materials submitted for examination. There is, however, no regular

office established for this purpose; the time used on such work has been taken from the spare time of the professor making the determination, which is made largely as a matter of courtesy and good-will, without charge. It happens frequently that a prospector finds something new to him; he wishes to get an idea of what it is and whether it may be of value; he cannot send it to the assayer and say, "Test this for gold and platinum", or some other particular metal, because he has no idea of what it may contain or whether it has any commercial value. If such material requires assay or analysis, he is advised to that effect and referred to a reputable assayer in the City. The amount of such work varies considerably from time to time; occasionally it becomes somewhat of a nuisance or burden to the individual to whom the specimens are sent or submitted in person; but it appears to be rather difficult for a member of the University faculty to take a positive stand that he will express no opinion to a visitor or to one who writes concerning a matter on which he is supposed to be more or less of an expert. Sometimes the amount of labor entailed is so great that nobody is willing to undertake it. Thus it is evident that the action to be taken by the professor or instructor resolves itself into a question of personal attitude, as the University has no rules for his guidance, and it is nobody's definite duty to attend to such matters, although the administration, on receiving letters of inquiry, usually refers them to individual members of the faculty for reply. We give these facts in detail because the customs established at our State University are probably similar to those obtaining in like institutions in other States. The same problem has arisen in connection with the U. S. Bureau of Mines. In a recent case that has excited criticism, an experiment station in Oregon made a detailed investigation into the metallurgical treatment of a low-grade quicksilver ore and published a report. It was claimed that this investigation should have been left to a private ore-testing firm and that it should not have been done by a Government bureau, more particularly as the results were useful only to the one mining company in Oregon that produced an ore of this particular character. In reply, it was stated that the investigation was useful to other mining companies, in California, for example, and that the results were published for public use, not for private assistance. It is the custom of the Bureau of Mines to publish its report on any such investigations promptly for the benefit of all those whom it may assist; moreover, the Bureau aims to select such subjects for investigation as are of general interest to those engaged in mining, and such as are unlikely to be referred to private practitioners. It seems to us, from what we know, that the U. S. Bureau of Mines is careful not to compete with consulting metallurgists, although occasionally its zeal for useful service may cause it to run counter to the ideas of those inclined to be hypercritical. The U. S. Geological Survey requires its officers to take an oath not to engage in private practice within the United States and not to divulge the information that they obtain in the course of their study

of geological conditions in particular mines, except in the printed reports duly published for the benefit of the industry as a whole. Occasionally a member of the Survey resigns and later becomes retained professionally by a mining company; it is then his primary duty to respect the spirit of his obligations as a former officer of the Survey and be keenly on his guard not to misuse the information that he obtained while under the restrictions of secrecy. Some years ago there arose a scandal at Butte owing to the laxity of an ex-Government geologist, but, in the main, the honor of the Survey has been respected, so that it is very rarely indeed that it has been possible to make any just complaint on this score. However, although the geologists of the Survey are not permitted to engage in private practice in their own country, they are free to do so abroad. They have availed themselves of the opportunity to make reports on mines just over the border, in Mexico and Canada, and farther afield in other regions. In doing so they have used their prestige as Government experts to compete with independent practitioners, and, what is worse, they have diminished the prestige of the U. S. Geological Survey, because their reports have not been worth the fees paid for them. The plain truth is that the scientific study of a geologist, unless supplemented by previous practical experience in mining operations, is not worth much as a means of valuing a mine. The opinions of even such men as Clarence King and S. F. Emmons concerning the prospects of a mining enterprise had an academic interest only; they failed in making a reliable commercial appraisal. We recall how one of our most distinguished of living geologists was engaged to report upon a group of alluvial mines in Australia and how he described the geologic history of the deposits with skill and insight, but he was unable to estimate the amount of gold or the quantity of water in the gravel, because he was without practical experience either in the sampling or the working of such mines, so that his report was entirely too optimistic, failing altogether to forecast the disaster that overtook the enterprise at an early date, owing to insufficient gold and excessive water. We venture to say that the true scientist usually lacks the commercial sense; he is utterly unfitted to appraise mines, and when he engages to do so, he is doing something *supra crepidam*; in short, it would be right and proper, and for the good of all concerned, if the U. S. Geological Survey were to extend the scope of its regulations and place an embargo upon mine-reporting by its members not only at home but abroad. This should not interfere with the 'lending' of its best men for important work in behalf of other governments, for example, to perform such work as would enlarge the knowledge of our Federal geologists and contribute to the growth of the science itself, but even then it should be stipulated that the results would be published in English in this country; and of the fee, which should be large, one-half might be set aside for a fund to assist super-annuated members of the Survey. We shall discuss other phases of this subject, with particular reference to professors, in our next issue.



Silver

The Editor:

Sir—There has been a great deal written about gold during the past year, while silver has been comparatively neglected. I believe that if an authoritative article on the status of silver was published in the 'Mining and Scientific Press' it would be heartily welcomed.

I have heard many reasons advanced to support the belief that the price for silver will be maintained at a high average for many years to come, but have heard very few opinions that hold to the contrary. Let me enumerate some of the former:

India and China must take greatly increased quantities, because the standard of living in those countries has been advanced greatly, perhaps doubled, and therefore approximately twice as much silver will be needed by them in the future as in the past. The former Russian Empire and the new states in Europe, as well as some of the old ones, are quite 'fed up' with paper currency and will demand metallic money in the future. Mexico, as you know, has passed through such an experience, and, it is argued, the same thing will happen in the countries mentioned. The United States and the principal European countries will require a greater amount of silver for circulation purposes than formerly, in order to meet the demands of higher prices and a greater volume of business than before the War. The arts employing silver will require an increasing amount annually.

The prospect for a decline in gold production supports the belief that eventually silver will have to be remonetized throughout the world.

It would be most interesting and instructive to see an article showing the annual demands of India and China and the amounts absorbed each year by these countries; the world's silver production, showing the amount produced from mines operated primarily for the production of silver as distinguished from other mines in which silver is a secondary consideration; the annual requirements of the arts; the annual requirements of the world's coinage; the possibilities of greatly increased production should the price remain at a high level.

We all remember, about ten years ago, when several new 'porphyry coppers' were about to commence production on a grand scale, how many of the authoritative voices in the copper world predicted an overproduction and consequent drop in price; and how, even before the War, the increased production was easily absorbed and the warnings of the prophets were proved to have been unnecessary.

Is there much encouragement for hoping, in the case of silver, so long the "weak sister" among the metals, that a high level of prices is to be expected indefinitely, regardless of increases in production?

Culiacan, Mexico, December 1. E. P. CRAWFORD.

[By this time Mr. Crawford will have read the editorial on the status of silver in our issue of December 20. We have discussed the subject a number of times during the last six months, for, of course, it concerns a great many of our readers.—EDITOR.]

Gold and Silver as Money

The Editor:

Sir—Responding solely to the rule of supply and demand, silver has acquired a position in the commercial world which brings it on a parity with gold; in other words, 'bi-metallism' promises to be re-established regardless of the wishes of Wall Street and the monometallist. The rapid advance in silver quotations has startled the financial world and the fact that a silver dollar is worth more in bullion than it is in coin will result in the final withdrawal of silver from circulation. It will be as scarce in the transactions of business as gold is already.

Disturbance of exchange-rates on international money transactions is a natural result and direct outcome of the War; principally this is due to the enormous credits. The business world is unable to readjust its operations on the basis of the present gold standard.

The Government must resort to some expedient of recoinage, and to do this we must remove the old standards of value which were established by an act of the British parliament in the year 1802, and adopted by the United States government in the year 1820; otherwise, in order to maintain the old standard, we must increase taxation to practically double the present levy.

The fundamental object of taxation is not to impose a burden or a penalty on the taxpayer; rather the opposite: to secure funds by means of which the Government may be enabled to extend to the taxpayer those benefits which he could not so well, if at all, secure for himself. Consequently, any program of taxation should be administered with the utmost sympathy and consideration and with the least possible disturbance of the taxpayer's normal activities. Already taxes have been levied until these burdens cannot be carried by the common people, and to tax industry further means to curtail

the output, lessen the production, and thereby increase the cost of living.

Nations as well as individuals must pay their debts. Today the United States of America is the only solvent concern in the world; and it is carrying a bonded indebtedness of practically thirty billion dollars or a principal sum of \$275 for each person in the United States. The interest levied pro rata would be \$13.75 a year.

The first duty the Government owes its people is to begin paying its debts and get back to doing business as soon as possible on a hard-cash basis, which is a sure cure for the economic ills of the nation. But how can this be brought about? First, Congress should adopt a measure for protecting the Treasury reserves and reducing taxation. This can be done by adopting a bi-metallic monetary system. Call in all metallic specie and re-issue gold and silver coins in one-half the present size. With the surplus from re-coining, retire a portion of the present bond issues. Then adopt a standard for gold at \$41.34 per ounce and a value for silver of \$2.50 per ounce. Such an act of the Government will relieve the burdens of taxation and will greatly stimulate the mining industry; it will pour more wealth into the coffers of the Treasury; labor will be employed at a wage that will do away with strikes, and the opportunity will be offered to every person in the United States to receive employment. The reducing of the size of the American dollar will give a dollar a purchasing power equal to its value and will enable the United States as a nation to expand its industry and commerce and in this manner we will have solved the question of the High Cost of Living and reduce taxation.

Omaha, December 15.

ROY M. HARROP.

[Our correspondent suggests a variety of measures with which we disagree entirely, but it is our policy to give space to expressions of opinions opposite to our own.—EDITOR.]

The Crowe Process

The Editor:

Sir—Referring to the various discussions on this subject, the contention that the application of the process by Mr. Crowe was not original does not appear to be well founded nor well supported. That the principle was understood and frequently mentioned in literature on the subject cannot be questioned, but that anyone fully appreciated its importance or made any deliberate attempt to apply the principle remains to be proved. All claims that have come under my observation rest on accidental or incidental application in connection with vacuum filtration. That any appreciable benefits were derived by incidental application of the vacuum in filtration is questionable. I think the only claims worthy of consideration are those by Philip Argall, and these are supported more by his reputation than by his statements, which it is the purpose of this communication to prove.

It is my understanding that the material question is whether or not anyone anticipated the Crowe process by deliberately subjecting a pregnant solution to a vacuum for the purpose of improving precipitation by the re-

moval of oxygen. I do not question that Mr. Argall is sincere in his belief that he either accidentally or intentionally anticipated the Crowe process. However, he does not make any definite statements that it was intentional, but he has presented his data in such a way that the natural inference is that the application was intentional. This presents a rather delicate situation, and I am forced to say that if the application was intentional the methods were decidedly crude for one of Mr. Argall's attainments. The purpose of this letter is to prevent the uninited from 'kidding' himself into the belief that the benefits of the Crowe process are obtainable by the arrangement described by Mr. Argall.

Permit me to digress for a moment to criticize Mr. Argall's terminology. I will show later that the point I make has some bearing on the question. I object to the use of 'gas' as a substitute for 'air'. Strictly speaking, it is correct, but it is not generally used, and general usage is, I take it, the measure of accuracy. The use of 'gas' to distinguish air in solution might be permissible, but Mr. Argall does not make this distinction. To quote, page 393, second column, line 14: "The evolution of gas, however, proved so vigorous that foam occasionally passed over into the air-pump." This statement is decidedly misleading. The natural inference is that the evolution of gas was a measure of the efficiency of the vacuum in separating dissolved air from solution. On the contrary, it was a measure of the inefficiency of the filter. Water absorbs about 2½% by volume of air at 0° and sea-level. This varies inversely as to temperature, altitude, and amount of salts in solution. The decrease is compensated by expansion at higher altitudes, and if volume is considered, which is quite proper, the proportion might be slightly greater than the amount stated. In any event, it is insignificant. The amount of air passing through a vacuum system of a leaf-filter is roughly speaking from 10 to 100 times the amount necessary to saturate the solution handled. Hence my objection to the general terms, 'gas', 'de-gasser', and the paragraph previously quoted. I would like to ask Mr. Argall why he did not "de-gas" the solution from the leaching-vats if, as is intimated, he at that time realized the advantage of doing so.

I cannot see what bearing the amount of zinc used per ton of ore has on the question. This could be of only comparative value under any circumstances. The real measure of efficiency in precipitation is the ratio between the zinc and the metal precipitated. The evidence offered by Mr. Argall could be duplicated indefinitely, as the arrangement described was the usual one and dates from about the time of the introduction of the vacuum-filter. I cannot, however, see that it has any relation to the Crowe process. In slime-filtration the filtrate is usually turbid, especially with a leaf-filter, and clarification is a necessity.

Mr. Argall states that the solution was pumped from the separator to clarifiers, presumably sand-filters that served also as storage. The latter is not material.

E. M. Hamilton called our attention many years ago to the fact that cyanide solution containing a considerable excess of sodium sulphide was completely oxidized by

simply decanting from one tank to another. I quote this to illustrate the avidity with which cyanide solution absorbs air; and this is the point I wish to emphasize. The transfer of solution to an open tank after 'de-gassing' will result in neutralizing the effect almost instantly, and I hold that the essential feature of the Crowe process is contact with the precipitant after de-gassing without exposure to air. If anyone can establish the fact of having done this previous to Mr. Crowe he can fairly claim to have anticipated the invention.

El Paso, December 16.

JAMES S. COLBATH.

Fine Grinding in Ball-Mills

The Editor:

Sir—In looking over my article in your issue of January 3, I notice that graphs, Fig. 1 and Fig. 2, showing the sizing of feed to the mill and discharge from the mill

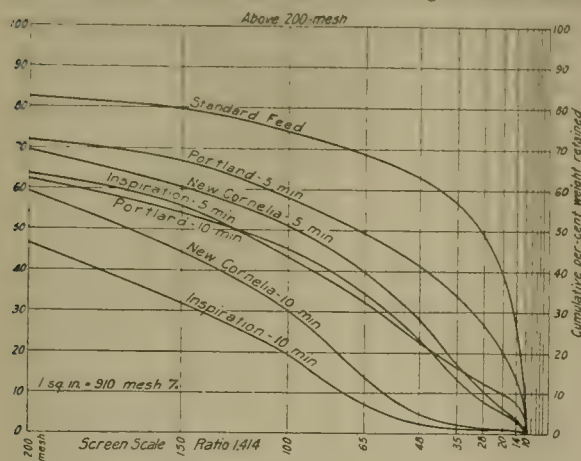


FIG. 1

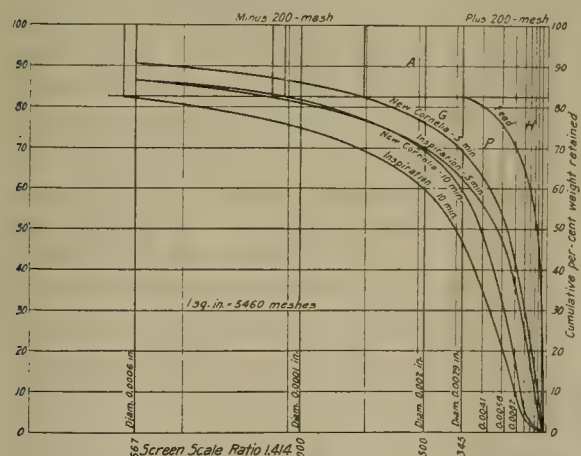


FIG. 2.

in plotted curves after five and ten minute grinding-periods were omitted inadvertently. I take this opportunity therefore to make the correction. The graphs are referred to on bottom of page 17 and top of page 18 of your last issue.

HENRY HANSON.

San Francisco, December 31.

Mine Surveying

The Editor:

Sir—There are certain statements in the third instalment of Mr. Waterman's series on 'Mine Surveying', particularly regarding the use of the 500-ft. tape for slope-measurements, that I should be inclined to question. I have never done any mine surveying but have used both a 300-ft. and a 500-ft. tape extensively for surface-work, and also in running railroad tunnels, the latter for setting points in the heading before the bench below had been taken out.

My experience indicates that to get a really accurate reading by simply measuring to a point on a plumb-line is impossible, even with a 300-ft. tape, much more so with a 500-ft. tape. In fact, even with a 100-ft. tape, it takes a careful and experienced head chain-man to give the tape the required tension to take up the sag, prevent the tape from disturbing the plumb-line, and read the tape, all at the same time. With a 300 or a 500-ft. tape errors of 0.1 ft. or more cannot be prevented.

The method that I have found to give the maximum accuracy, for reasonable expense in time and money, is to set a stake on line, taking special precautions to make it solid, centre it with a tack, and take the measurement to the tack. Where a stake cannot be driven because of rock, use a 'gad' or something similar, and scratch a temporary point on the top. Four men are needed for a really accurate measurement, provided the distance is much greater than 100 ft., one at each end to pull on the tape, and one at each end to read it. If extreme accuracy is desired, a spring-balance and a thermometer should be used, and the observed length corrected for tension and temperature. Except for special cases, I do not believe that the slight saving in time for the 500-ft. as compared with the 300-ft. tape compensates for the greater convenience of the shorter tape. There is, however, no question that the use of slope-measurements corrected for the vertical angle gives greater accuracy and speed for both surface and underground work than where the method of 'breaking chain' is used.

San Francisco, December 19.

A. T. PARSONS.

The Burma Mine

The Editor:

Sir—In your issue of November 29, under the heading of 'The Burma Mine', the following statement appears. "Mr. R. G. Hall formerly in Missouri is resident manager. He succeeded Mr. C. H. MacNutt, who resigned in 1916 and served with the engineer corps of the Canadian army in France."

Apparently you are not aware of the fact that Mr. Thomas E. Mitchell succeeded Mr. MacNutt as resident manager in 1916 and continued in that capacity till August 1918. Mr. Mitchell as mine manager, and afterward as resident manager, not only developed the mine to such an extent as to expose several million tons of ore, but also conducted this work so efficiently that in the future the Burma Mines Ltd. will be noted for its low

cost of mining operations. A resident manager, too, owing to his energetic control of operations, he was responsible for the great progress in metallurgical and engineering operations which marks this period in the history of the company.

W. SHELLSHEAR.

San Francisco, December 2.

[Yes, we were aware of Mr. Mitchell's management, but overlooked it inadvertently. We are glad to publish this correction, and with it the tribute to his good work by one who is well qualified to pass judgment.—EDITOR.]

Panama Museum

The Editor:

Sir—I have just received a letter from the Director of the Colegio de La Salle, Plaza De San Francisco, Panama City, requesting the co-operation of the Bureau in securing additional material for the mineral collection of the museum, on the ground that a great many people from almost every nation in the world pass through Panama and visit the museum, and that an adequate exhibit of American material there should be of benefit in contributing to a greater knowledge of American materials and the extension of trade.

On this ground the Director asked me to request the principal mining firms of the United States to send the museum samples of their minerals and products. As the columns of your journal are the most effective way of transmitting this request, I am passing it on to you for such action as you may deem desirable.

T. T. READ,

Engineer in Charge,

Div. Education & Information.

Washington, December 22.

Simplified Spelling

The Editor:

Sir—I thank you for the opportunity to reply to your editorial note of December 27, though I wish you had allowed more space. In the 1917 election 765 ballots, a majority of 336, were cast in favor of the adoption of the 12 words recommended by National Education Association. This majority was nullified by the unusual method of counting blank ballots as negative votes. It, therefore, seems very probable that if the overwhelming vote you demand is forthcoming that other reformed spellings will be adopted, *tho* and *thru*, for example. I welcome the publicity now being given to the spelling-vote, for if the arguments are carefully studied, I feel sure, gain will result to spelling reform. The Institute now uses so many reformed spellings (catalog, gram, program, sulfur, sulfid, and others) that this anguished plea for protection against the admission of a few more short spellings seems childish. The title of page xx of the December bulletin, "Simplified Spelling Foisted Upon Us", seems an improper designation to apply to the attempt to ascertain the wishes of members by a procedure explicitly set forth in the constitution of the Institute. The paragraphs you

mention, as an example of the horror of simplified spelling, were not written by me and I first saw them in the Bulletin. I am using reformed spellings in my notices, but these spellings have been authorized by a vote of the executive committee of the San Francisco section. While I deeply regret that any of my actions should have irritated you, yet I cannot help feeling that the underlying source of your irritation is a subconscious feeling that there is more justice on the side of the spelling reformers than you consciously realize. On page 912 you quote that 25% of the drafted men could not read or write. Educators attribute much of this illiteracy to our difficult spelling. The Chinese government, in November 1918, authorized a system of phonetic spelling that enables the illiterate Chinese to learn to read in a month; so important is this considered by the governor of Shansi that he has ordered every person in his province to learn to read instantaneously under severe penalties. Can we not follow, even if far behind, the progressive Chinaman? The argument that it is not the business of the Institute to benefit the coming generations seems especially weak, for we shall benefit most by adopting an additional measure of simplified spelling and the benefit to the children will be incidental.

W. H. SHOCKLEY.

Written amidst the melting snows. Truckee, December 29, 1919.

[Whether "amide" is simplified spelling, we do not know. Mr. Shockley was told that he could have as much space to reply as the Editor took for his paragraph. Of course, we feared an inundation of propaganda for 'simp' spelling. Mr. Shockley is not quite correct when he says that his use of his way of spelling was authorized by the executive committee of the local section; the fact is, he used it before such authorization was given. We hope earnestly that members of the Institute will not fail to vote on the question, taking care not to be confused by the obscure way in which the issue is stated in the official circular. In the 1917 vote, only 1194 members, of 6000, voted; unless members pay attention to the matter, we may be victimized by Mr. Shockley's persistent propaganda.—EDITOR.]

QUICKSILVER, although not a precious metal nor like iron, copper, and zinc one of the great basic materials of industry, nevertheless has the unique position of being the only metal that is liquid at ordinary temperatures and its varied and special applications in science and the arts give it peculiar interest. A report of the U. S. Geological Survey, prepared by F. L. Ransome, not only gives the domestic production of quicksilver as a whole and by States for the year, but presents also the latest obtainable figures for the world's production and contains information on the quantity and character of ore treated, methods of reduction, prices, imports and exports, and uses of quicksilver. The report also contains notes on the operations at individual mines and a table wherein are listed most of the quicksilver mines of the United States with notes on the character of the ore deposits, reduction equipment, and total output of each mine.

The Bunker Hill Enterprise—II

History of Idaho and Beginning of Mining Operations

By T. A. RICKARD

The historian Bancroft says of Idaho: "Taken altogether, it is the most grand, wonderful, romantic, and mysterious part of the domain enclosed within the federal union." I shall not quarrel with his eulogy, for it is my desire to interest the reader in that part of the United States in which is the subject of these articles, the Bunker Hill mine. Besides the locality of this celebrated mine, I have some acquaintance with other parts of Idaho, and, if more sparing in adjectives than the historian of the Pacific Coast, I can testify that Idaho is a beautiful and interesting region. The word 'Idaho' is generally supposed to mean 'Gem of the Mountain', and it may well be agreed that the State is a jewel in the crown of Uncle Sam; but there is another and more probable derivation. I am told that 'Idaho' is an Indian word used by the Nez Percés to describe the phenomenon observed in the early morning when the nearly horizontal rays of the rising sun touch the mountain-tops while the valleys are still shrouded in darkness. It is what we would call a 'sun-burst'.

We have traced the early history of this north-western region up to the point when it became a part of the United States and was organized as the Territory of Oregon. When the whole of Oregon became a State, in 1853, it retained the southern portion of the present State of Idaho, but lost the northern portion, which became included in the Territory of Washington. This remained within Washington until 1863, when the Territory of Idaho was organized, with William H. Wallace as Governor; this included the present State of Montana until 1864 and a part of Wyoming until 1868, when the area of the Territory of Idaho was reduced to that of the present State. In 1890 Idaho was admitted into the Union, and the first Governor was George L. Shoup.

That part of the United States now comprised within the State of Idaho was first explored by white men when the Lewis and Clark expedition crossed it in 1805. They traced the Snake river to its junction with the Columbia, as we have seen, and they made Fort Lemhi a rendezvous for the two divisions of their party. They camped among the Nez Percés on the south fork of the Clearwater river, where, it is said, they found traces of other white men. Indeed, it is noteworthy that the explorers famous in the history of the West have usually found other white men ahead of them—French trappers, British fur-hunters, or American prospectors—who had made friends with the Indians and married among them, becoming 'squaw men', and thereby being admitted to the aboriginal knowledge of the country. Such was Chaboneau, the French-Can-

dian trapper who married the famous Sacagawea, a Shoshone woman, with whom he accompanied the Lewis and Clark expedition, to which both husband and wife proved of great service as guides. Another was Drewyer, the son of a Canadian and a squaw, who was particularly helpful in killing game for food in January 1805 when the same expedition was extremely short of provisions.

The rivalries of the fur companies caused Idaho to be explored again at a later day. In 1810 Fort Henry, on the Snake river, was established by the Missouri Fur Company, which had done so much to impede Astor's representative, Hunt, in his journey to the coast. In 1811 a party of the Pacific Fur Company, controlled by Astor, descended the Snake to its junction with the Columbia. Then came missionaries, both Catholic and Protestant, among the Indians. These traveled along the trails that the trappers and packers had established across the Bitter Root range, which separates Idaho from Montana and the Missouri valley. In October 1841 Father DeSmet, a Jesuit priest, visited the western slope of the Bitter Root mountains, on his way to the coast. He descended into the valley of the Coeur d'Alene river and ministered to the Indians of that name, a name they owed to a tricky trader, whom, when he tried to get the best of them, they called *coeur d'alene*, or heart of an awl. The traders, for lack of a better name, thenceforth spoke of these Indians as the Coeur d'Alenes. They were a docile tribe and begged DeSmet to establish a mission among them. In the following year, 1842, he appeared again and in the autumn he founded the mission, for which a church was erected in the basin of the St. Joseph, a stream tributary to the Coeur d'Alene river. Owing to a flood, the church was removed in 1846 to its present site, 12 miles below Kellogg. There Father Ravalli labored for seven years, and there the signs of his artistic handiwork are still to be seen. The old church was built without a nail; instead a hole was bored and a wooden pin was driven through. The Mission became a landmark on the trail across the Bitter Root mountains from the Missouri to the Columbia valley. Father Ravalli exercised a wide influence, promoting peace among the red men and protecting the lives of the white men. The light in the window of the Mission was a beacon to many of the packers and prospectors that came down the trail weary from battling with the snow in the mountains. From the Jesuit fathers they always received a cheery greeting and found protection from the storm. It was the trade with these Indians that led to the discovery of the mineral wealth of the region.

In the spring of 1849 the gold excitement in California attracted many of the pioneer settlers from the North-West. Ten years later gold was discovered on the Similkameen, in British territory, just over the northern boundary of Washington, and in 1860 the placers of the Cariboo, at the head of the Fraser river, stimulated prospecting in this part of the world. Through participation in the working of these discoveries, north and south of them, the people of the North-West obtained some knowledge of the technique of mining and were prepared to find and to exploit the mineral riches within their own borders.

To E. D. Pierce belongs the honor of being the pioneer of mining in Idaho. He was a trader among the Indians and through them he had long known that the country east of the great bend of the Snake river was gold-bearing, but he did not dare to undertake prospecting operations for fear of arousing their enmity. He had been in California and knew something about placer mining. In 1858 Pierce re-visited the Nez Percé country, but found no opportunity to search for gold until after the ratification of the Nez Percé treaty and the general cessation of hostilities between the Indians and the white settlers in 1860. Early in that year he was enabled to verify his belief that there was gold in the gravel of the Clearwater, a branch of the Snake, and he so reported in April at Walla Walla, which was then the nearest distributing point. Pierce did not return at once to the Clearwater, on account of opposition from both the Indian and the military departments of the Government. These dreaded a renewal of trouble with the Nez Percés and Spokanes in the event of a mob of prospectors over-running their reservations.¹ In August, however, Pierce was enabled to set out from Walla Walla for the purpose of making a conclusive examination. He appears to have been a careful and sagacious man, unwilling to commit himself to an opinion until sufficient evidence was available. He ascertained that the diggings were dry and yielded 8 to 15 cents to the pan. Having satisfied himself that profitable mining was feasible, he tried to organize a large company to return with him and remain on the ground during the winter, but the fear of attack by the Indians was a deterrent to adventure, so that only 33 men were willing to accompany him. Pierce himself, although convinced that the gravel on the Clearwater was fairly rich, was quite free in exposing the disadvantages of the undertaking and did not hesitate to declare his belief that these placers were but the fringe of still richer ground. By the time 300 men had set to work in the district, which was named Oro Fino, a treaty was negotiated with the Indians. A month later the number of diggers had increased to a thousand. This was in the spring of 1861.

When the rush began from Portland and Walla Walla to the mines, a steamer went up the Snake river to the mouth of the Clearwater and up that stream to within 40 miles of Pierce City. In the early summer of 1861, the navigation company joined with the miners in selecting a site for a town at the junction of the Clearwater

and the Snake. A suitable site was found between the two rivers and it was called Lewistown, in compliment to Meriwether Lewis, of the Lewis and Clark expedition, who had discovered these rivers and had been entertained by the father of the chief of the Nez Percés almost at the very spot where Americans were now digging for gold.

By July 5000 men had scattered over the surrounding region and prospecting had been extended to the south fork of the Clearwater, where a town called Elk City was established with a population of 2000. This was 120 miles south of Oro Fino.² In July a party went still farther south to the Salmon river and in September made a discovery of gold that created such excitement as almost to empty the older mining camps. Bancroft states³ that "John Munsac purchased a claim [on the Salmon] for \$1800 and from two pans of the dirt took four ounces of gold. In two weeks he had taken out 45 pounds of dust."

Nathan Smith, a Californian pioneer, discovered gold at Florence in the following winter, 1861-62, and in 1869 the same prospector was responsible for starting mining at Oro Grande. In 1862 there was a large immigration from the Eastern States, owing to the Civil War and the fame of the Salmon River diggings. By 1863 there were four county organizations and ten mining towns, containing in all 20,000 inhabitants, most of whom were pioneers from the Pacific Coast and the Western States—a population of energetic and resourceful men. This industrial development caused the organization of the Territory of Idaho in 1863; it included all that portion of Washington lying east of Oregon and the 117th meridian of west longitude.

Shoshone county, in a remnant of which is the Bunker Hill mine, was the first portion of Idaho to be mined and settled; it was in the southern part of the county that Captain Pierce made the first discoveries. Bancroft states: "The county of Shoshone was set off from Walla Walla county by the legislature of Washington as early as January 29, 1858, comprising all the country north of the Snake river lying east of the Rocky Mountains, with the county seat 'on the land claim of Angus McDonald'." He had been the Hudson's Bay company's agent at Colville. The county was divided by legislative enactment in 1860-61 and in 1861-62 as the requirements of the shifting population demanded. Bancroft reverts to the nomadic character of the early miners and describes this characteristic in felicitous phrase: "The miners of Idaho were like quicksilver. A mass of them dropped in any locality, broke up into individual globules, and ran off after any atom of gold in their vicinity. They stayed nowhere longer than the gold attracted them."⁴

In 1863 the gold-quartz veins of the Boisé basin and in 1865 the Poorman vein on War Eagle mountain, in Owyhee county, were discovered, each of these events inciting a mining stampede.

Although the discoveries of gold-bearing gravel on the

²Pierce City was the first camp. It is at the mouth of Canal gulch, on Oro Fino creek.

³Op. cit., p. 247.

⁴Op. cit., p. 427.

¹The Works of Hubert Howe Bancroft, Vol. XXXI.

streams tributary to the Clearwater marked the beginning of successful mining in central Idaho, these diggings did not last long and their population soon drifted southward to the Salmon River and Boise districts.

These diggings proved disappointing, but six years later fresh discoveries gave new life to the district and led to the founding of Moose City, which continued fairly prosperous until the early 'seventies. The mention of this



MAP OF NORTHERN IDAHO. THE BUNKER HILL MINE IS AT WARDNER AND THE MILLS AT KELLOGG

When the placers of Pierce City, Oro Fino, and Elk City became exhausted, they passed largely into the patient hands of the Chinese. In 1862 there was a rush to Moose creek, at the headwaters of the north fork of the Clearwater and 40 miles north-east of Pierce City.

locality is essential to my story because it indicates the northward extension of mining exploration, bringing prospectors nearer the Coeur d'Alene, the northernmost portion of Shoshone county, which by this time had become depopulated and impecunious. In 1881 the assessed

valuation in the county was only \$38,981. The 'Lewis-town Teller' of July 21, 1881, said: "Our Pierce City [which was then the county seat, it must be remembered] correspondent announces the partial disorganization of Shoshone, leaving the people of that county without any executive officers. For some time past offices in that county have been compelled to go begging for men to fill them, and when once filled several substitutions have been made after periods of interregnum. The whole number of white residents in the county seldom exceeds 75 persons, and is more often less than that. . . . The increase, when there has been any, has been principally among the Chinese, who have gone there for mining purposes and bought the greater portion of the ground that had been worked by the whites."

Fortunately the county organization was maintained, even though it was precarious. Better days, however, were in store for Shoshone. For many years the existence of gold in the Coeur d'Alene had been rumored. It is stated that as early as 1853 gold was discovered in the Coeur d'Alene by Donelson, of the Stevens expedition, but the hostility of the Indians kept prospectors out of the country. In 1858, when Lieutenant John Mullan surveyed the military road across the Bitter Root mountains, the members of his expedition, most of whom had mined in California, noticed outcrops of likely-looking quartz and some of them actually found gold, as is recorded in a letter that Mullan wrote, from Washington in 1884, to the editor of the 'Eagle', a paper published at Eagle City, of which mention will be made later. Mullan, in that letter, told how one of his hunters, named Moise, a French-Canadian, had come into camp one day with "a handful of coarse gold which he said he had found on the headwaters of the north fork of the Coeur d'Alene". His statement was discredited, it being assumed that "he had traded for this gold with some parties passing up and down the Fraser River mines", as Mullan says. This was in 1858-59. Other finds were made by Mullan's men at intervals along the trail that he surveyed across this region, but he did nothing to encourage interest in them because he feared to lose his men and thereby endanger the completion of the task he had in hand, which was, as he says "to open a base line from the plains of the Spokane on the west to the plains of the Missouri on the east, from which other lines could be subsequently opened, and by means of which the correct geography of the country could be delineated". He aimed to ascertain the most practicable route for a wagon-road that could eventually become the line of a railroad; and he succeeded, for the Mullan trail was followed later by the Northern Pacific railway.

The white men that first penetrated into this region found a trail leading past the Old Mission. Over this trail the Indians used to cross the Bitter Root range and when the time came to build a wagon-road, the surveyor, Lieutenant Mullan, found no better route; when the Northern Pacific sought an entrance into the Coeur d'Alene, it, in turn, could find nothing more suitable than the Mullan road, and so the old trail became the line of a

railroad.* From Wallace to the Mission the railroad followed the moccasin feet, and from there across the lake the steamers followed in the vanished wake of the Indian canoe. The old narrow-gauge line was built in 1887 by the late D. C. Corbin, the famous railroad-builder of the North-West; it extended from Burke to the Mission landing, and in 1896 was replaced by the broad-gauge line of the Union Pacific which entered the Coeur d'Alene from Tekoa, Washington.

In 1873 Frank Peck and John Vollmer found gold in the course of a prospecting trip between the St. Joe and Clearwater rivers, but nothing came of it. The first successful prospector in the Coeur d'Alene was Tom Irwin, who worked a quartz vein on the Mullan road, near a place called the Miner's Cabin, in the spring of 1879. He formed an opinion that gold-bearing gravel would be found in the vicinity, but he failed to find any. In 1881 he met A. J. Prichard, who was engaged in the lumber business, and told him what he thought of the prospects of placer mining in the upper reaches of the Coeur d'Alene river. This was in 1881. Soon afterward Irwin went to Colorado, but Prichard had become interested. To him belongs the credit for disclosing the riches of the region. In 1882 he found gold on several of the creeks tributary to the north fork of the Coeur d'Alene river. One of his first finds was on Eagle creek, but his most important discovery was on the creek that is now known by his name, at a spot near the site of the present town of Murray. In March 1883 he located four claims, one of which was in the name of his son, and the other three in the names of personal friends, he himself retaining a half-interest in each claim. Besides this discovery group, he located a number of other claims for various friends by power of attorney. Prichard belonged to an organization called the Liberal League and he was anxious that his friends in the League should have the first chance to share the benefits of his discovery, so he wrote a letter, reproduced by the 'Spokane Review' in 1888, in which he invited them to come to Idaho and "secure the lion's share" of the mineral wealth he had uncovered. His letter is dated January 7, 1883, and is written from 'Evolution', which was the name of his camp on the Mullan road. It is so interesting that I shall quote the principal portion of it:

"I have made a discovery of a gold-bearing country that will give employment to at least 15,000 to 20,000 men. There are two streams that I have prospected well; one is 16 to 25 miles long, as near as I can judge; the other 12 to 16 miles and an average width of 60 to 70 rods; have found gold on three other streams of near the same size, but have not tested them enough to know how they will pay. The two streams I speak of will pay their whole length and probably the most of their tributaries, with an abundance of good timber and water. Bedrock from 5 to 12 ft. Gold coarse and of good quality. There are two good and natural town-sites where there will be built cities representing thousands in

*'Following Old Trails', by Arthur L. Stone, p. 162.

less than two years, and the country is traversed with hundreds of mineral-bearing lodes of quartz. And now for good reasons which I have not time to explain I would like to see as much of this go into the hands of the Liberals as possible, and also see them build a city where they can have their own laws and enough of this vast mining region to support it, which they can do if they



NORTH FORK OF THE COEUR D'ALENE RIVER

will go at it cool and work together. I have spent four years by myself looking and working it up. I first discovered and located a lode in the Mullan road, and not having much means to open it up, I spent all of my spare time looking for placers, not anticipating finding extensive mines, only something to help me open my lode, but I have found a richer and bigger section than I supposed lay undiscovered in the Rocky range, and now if you will convey the purport of what I have given you to as many Leaguers as you can on this coast, and request them to get together and keep this information to themselves, they can secure the 'lion's share'. I am in the mountains, fifty miles from a post-office, and can do but little in winter, for the snow gets from three to four feet deep here. I will give directions how to get there and what is needed. My location I call Evolution, as that is the name of my lode. It is on the old Mullan road to Montana. I am 50 miles east of Fort Coeur d'Alene and 23 miles east of the Old Mission. The Northern Pacific railroad runs within 12 miles of the post, where there is a town called Rathdrum. Parties coming will want pack-animals, as the new mines are back from my place on the road 40 miles in the mountains, with but poor pack-trails yet, as I have not had time to cut them out more than enough to get through, and they will want supplies for a month or two, as there will be no chance of getting anything after leaving the post at present. Probably the best place for those

that have to buy horses would be to stop at Spokane Falls, Washington Territory, which is 30 miles from the post, and perhaps they might do better in provisions and groceries, tools, etc. Now, if there are many that conclude to come, they might leave the impression along the road that they were going to Montana and give as many Liberals as possible a chance to get in before they get up an excitement."

Prichard's letters caused a stampede from Montana and Colorado to the gold belt of the Coeur d'Alene in the spring and summer of 1883. His Liberal friends were not discreet, but allowed the news to leak out, so that it reached the Black Hills district, in South Dakota, and induced a crowd of miners to migrate to Idaho. When these, and others from other parts of the country, arrived, they found that Prichard had located all the



THE OLD MISSION

best ground by power of attorney for his friends. They began at once to jump his claims. This led eventually to a long and costly series of litigations. Another cause of trouble arose from the fact that many farmers from the Palouse country and others whose principal occupation was not mining took advantage of the law to locate a claim—20 acres of placer ground—and hold it by doing the small amount of assessment work legally required, without engaging in active development, meanwhile giving their attention to their business elsewhere. The real prospectors found much of the best ground plastered with locations belonging to men who left them unworked; whereupon, of course, they jumped them. This led to litigation and sometimes violence.

Among those attracted to the district in 1883 was H. C.

Davis, of the Northern Pacific railroad, who saw an opportunity to secure patronage for his road and to encourage a settlement of the country contiguous to it. So he issued a circular, which has become famous in local history, because it induced a further rush to the district in the winter of 1883-84. It is amusing on account of its flamboyant phrasing, worthy of the prospectuses of a later day. I quote herewith:

"The claims are very rich, and are located in the gulches of the north fork of the Coeur d'Alene river, Eagle, Prichard and Beaver creeks, streams running into the Coeur d'Alene. Rich placer deposits have already been discovered for a considerable distance on Prichard creek and the same distance on Eagle creek, the creeks being known by the latter name from the point where they come together. Nuggets have been found which weigh \$50, \$100, \$166, and \$200. An intense excitement has sprung up in regard to the quartz deposits of this district, the immediate occasion of this being a find of a valuable quartz lode at the head of Prichard creek. The vein has been traced on the surface for a distance of five hundred feet and the outcroppings are very prominent. The ore taken from the vein shows a great amount of free gold; in fact, it fairly glistens. The most extensive galena belt known at the present day is being developed on Beaver creek. The vein can be readily traced on the surface for five or six miles, the ore carrying from 80 to 90 ounces of silver and 35 to 40% lead. Such is a brief sketch of the Coeur d'Alene mines, which surpass in richness and volume the most fabulous quartz and placers ever discovered, even the famous deposits of Potosi being inferior to those which underlie the mountains of the Coeur d'Alenes. As the mines of the old world, some of which have been worked since the eleventh century, are still employing thousands of men, the conclusion to be drawn in regard to the Coeur d'Alenes, a region far superior in every way, is that they are inexhaustible, and although thousands may work them, there will still be room for thousands more."

The first town to be laid out was Eagle City. In March 1884 lots sold at prices ranging from \$200 to \$2000. In the 'Nugget', the local paper, of March 22, 1884, it is stated that twenty new business houses were opened in the mining district during the preceding week. In the same issue appears a warning against any Chinaman entering the camp on pain of expulsion or death, and the expulsion of the person importing any such Chinaman. Mail on letters cost 50 cents and it took as much as two weeks to make delivery from Spokane Falls. The buildings were made of logs and 'shakes'. Shoveling of the snow in front of them left a mound between them and the street. Big tents, with gaudy signs, emitted sounds of rudimentary music, the click of chips, and the clink of coin passing over a bar. At the corners stood groups of men talking mines and mining, some of them examining specimens as they were passed from hand to hand. The stores exhibited specimens of gold-bearing quartz. A pistol shot would cause a transient flutter and the saloons would momentarily disgorge

a crowd. Pack-trains arrived, weather-worn and dilapidated from hard usage. The sounds of carpentering indicated the growth of the town. An air of expectation pervaded the community. It was full of life and hope—a transitory gleam. Eagle City soon lost its eminence; other 'cities' sprang up like mushrooms in the night; among them were Carbon City on Beaver creek; and Myrtle on Trail creek. Each of these had its little day; they flared up, only to be extinguished as the chances of discovery diverted the migrating population from one scene of excitement to another. As Bancroft says, it was a "mercurial" community, that of the miners.

In April 1884, encouraged by Prichard, a number of men went to Canyon creek and staked claims. Nine-Mile also was prospected. It is said that some of these prospectors filed claims on the very ground in which the famous silver-lead mines were developed at a later date, but they were looking only for placer gold, and, being without experience in any other kind of mining, they missed many chances.

The 'History of Northern Idaho', from which I have obtained some of my information, has much to say concerning the homicides and other acts of violence that punctuated, and punctured, the life of the pioneer settlements. It is pathetic to see so much space given to details that today possess nothing except a morbid and mortuary interest. For example, here is the record of a crime perpetrated at Murray in 1884.

"A homicide which attracted wide attention and roused the community to a high pitch of excitement was the killing of John Enright by Henry Bernard, July 2, 1884. The victim was a compositor in the office of the 'Pioneer', of which paper Bernard was editor. It appeared from the testimony at the preliminary hearing that Enright had been discharged and paid the afternoon of the homicide; that he came to the office for his blankets, but, instead of taking them and going quietly about his business, kept complaining to Bernard of the shabby treatment which he claimed had been given him. Bernard told him to go two or three times, but he still hung around the office. Finally Bernard drew a revolver and pointed it at him, telling him he must leave or get hurt. Enright received the threats in a jocular manner, and soon the fatal shot was fired."

At this time the county seat of Shoshone was Pierce City, as the reader will recall. When the northern mining districts began to assert their preponderant importance, there arose the demand for a change. The State legislature of 1884-85 passed a bill providing for the removal of the county seat temporarily from Pierce City to Murray and for a special election to be held in the county in June 1885 for the purpose of selecting a county seat. Osburn had the honor for a time. This, however, was a trivial matter compared with the finding of the silver-lead lodes in the autumn of 1885, for to them the Coeur d'Alene owes its enduring fame as a mining region and with the discovery of them begins the story of the Bunker Hill enterprise.

(To be continued)

A Contribution to the Study of Flotation—II

By H. LIVINGSTONE SULMAN

MOLECULAR CONSTITUTION OF SOLIDS AND LIQUIDS

According to the molecular theory, solids, liquids, and gases are composed of finite, physically indivisible particles or molecules, separated from each other by distances which are comparatively very small in solids, somewhat greater in liquids, and large in gases. All are in rapid motion, which increases with rise in temperature, and decreases with its fall; molecular motion, and consequently all chemical action ceases at absolute zero ($-273^{\circ}\text{C}.$). At $0^{\circ}\text{C}.$ the average velocity¹ of a molecule of hydrogen gas is computed to be 4100 miles per hour, or rather more than one mile per second. The velocities of molecules of other substances at equal temperatures are inversely proportional to the square roots of their molecular weights;

thus a molecule of silica at $0^{\circ}\text{C}.$ would travel at $\frac{4100 \times \sqrt{12}}{1.56}$ miles per hour, or about one-quarter mile per second. The average distance traveled between collisions will be small in a liquid and still smaller in a solid.

In a gas, the molecules are continually colliding with each other; being perfectly elastic, they rebound without loss of energy, and their impacts with the molecules of the walls of a containing vessel constitute the pressure exerted thereon by the gas. At atmospheric pressure the average travel between successive collisions (the gaseous

'mean free path') is about $\frac{1}{4,000,000}$ of an inch.

In liquid water, the molecules travel at an average speed of about one-third mile per second; being closely packed, their mean free path is small, probably less than the diameter of a molecule. Nevertheless, they move freely among themselves, giving rise to the mobility of the liquid as a whole, while their independent motions account for the facts of diffusion.

In a solid the molecules are subject to a yet greater constraint, though the general similarity between the volumes of the solid and liquid states for the same substance does not indicate a much closer inter-molecular spacing. They are conceived to oscillate for the most part about more or less fixed positions, with constant collisions with their neighbors. The phenomena of crystallization and magnetism show them to be capable of taking up definite axial directions or 'orientation'; but, being unable to move independently of each other, with any readiness, their assemblages possess rigidity and form.

¹Owing to their extremely frequent collisions and varying angular contacts, the velocities of the different molecules in the same substance, as also the velocity of any given molecule at different moments of time, must vary considerably; the mean velocity, as deduced by statistical methods, is that given.

Nevertheless, molecules in a solid can slowly change their relative positions and may cause extensive alterations in its structure, as in the gradual crystallization of masses of steel where there is a slow segregation and orientation of like molecules from an originally more complex molecular system. The molecules of one solid may travel into the mass of another, as in the mutual diffusions of lead and gold under pressure, and the many instances of 'solid solution'.

Transitional stages exist between the typically solid and liquid states, such as those occupied by pitch, waxes, ice, and many colloids; most solids other than crystals retain some degree of viscous character; while even some crystals show viscosity.

If, for want of more definite knowledge, we assume that molecules are spherical in shape, the diameter of a water molecule is 4×10^{-8} cm., or about two and a half million to the millimetre. The diameter of a hydrogen molecule is about half that of a water molecule; the diameters of complex molecules, such as those of tannic acid, soap, or albumen, are naturally much greater. A cubic centimetre of any permanent gas at $0^{\circ}\text{C}.$ and normal pressure contains 2.75×10^{19} molecules.

GRAVITATION AND MOLECULAR FORCES

The molecules of all substances are subject to both these forces. Gravitation is the force by which all the molecules in a body are attracted by those of another; it varies directly as the masses of the attracting bodies and inversely as the square of the distance between them. Gravitation, of course, is sensible at large distances, matter on the earth being sensibly attracted by the sun 95,000,000 miles away. Gravity is independent of the chemical nature of the substance, a gramme of lead exerting the same attraction on another gramme of lead as it would upon a gramme of lime or water at the same distance.

Molecular attractions are much more intense, but are manifested only over minute distances; consequently, they only come into play when the molecules are brought comparatively close together, and usually become insensible when the distance exceeds the ten-thousandth part of a millimetre, probably much less. Some physicists consider there are grounds for believing it to be of the order of $5 \mu\mu$.² The major limit for the diameter of a water molecule is computed as $0.24 \mu\mu$; therefore for water the radius of molecular attraction must be considerably greater than this, otherwise no attraction could

²The thousandth part of a millimetre, a 'micron', is written ' μ ', and the millionth part, a 'micromillimetre' ' $\mu\mu$ '.

exist between the molecules except when in contact. Johannot has measured an intensely black soap-film just before its rupture, finding it not more than $6\ \mu\mu$ in thickness, or a minimum of 24 molecular diameters.

Much larger limits have been assigned to the radius of molecular attraction; Plateau and Maxwell have suggested $118\ \mu\mu$ and Plateau and Quinke $50\text{--}59\ \mu\mu$ for the superior limits. Possibly it may be yet greater in certain cases; thus, in the selective adsorptions between saponin and the minute globules of an oil-emulsion at a water-surface, the latter fail to reach the surface of the liquid by a very small, yet visible, fraction of a millimetre. Again, the 'skins' or films of saponin, albumen, precipitated metals and their sulphides, and of mineral particles adsorbed at a water-surface, may often be of a visible thickness, vastly exceeding those above mentioned. Strong adhesive forces between the foreign particles themselves doubtless aid in the formation of such skins, but in these instances concentration proceeds cumulatively in a manner not easy to reconcile with a very small range of molecular attraction. All we can safely say is that the radius of molecular attraction may vary between $5\ \mu\mu$ and a fraction of a wave-length of light.

Unlike gravitation molecular attraction varies with the chemical nature of the molecules, and there is evidence (lately deduced by Edser) that the variation for different classes of substances is inversely as from the 6th to the 9th power of the distance. Thus for the lower limit doubling the distance between two like molecules reduces the attraction originally exerted by one upon the other to $1/2^6$ or $1/64$. There is thus a steep gradient in the intensity of molecular attraction even within the minute limiting distances through which these are exerted.

It is, however, to these forces of minute range that the properties of cohesion, adhesion, surface-tension, adsorption, etc., are due. While all molecular forces in ultimate origin are probably electrical, nothing is gained, in default of more exact knowledge, by assuming them to originate in this or in any other way; no more, in fact, than the laws of gravitation between masses are affected by the presumed electrical origin of matter.

In a gas, the molecules are so far apart that except at the moment of collision their mutual attractions may be neglected. In liquids and in solids, as we have seen, the molecules are much more closely packed, their attractions constituting cohesion, etc.; but even in solids the vibratory structure remains granular and molecularly porous, their surfaces being therefore penetrable to definite extents by the molecules of gases (gas-occlusion and permeability), of liquids, and in some cases even by the molecules of other solids.

COHESION. The attractive forces exerted on a molecule in the interior of a liquid or a solid by its numerous neighbors are without permanent resultant. Let Fig. 1 represent in vertical section a small mass of water, and the small circles the mean positions of molecules at any moment. If an imaginary plane $A\text{--}B$ be traced, the molecules immediately on one side of this will attract those

on the other with the same force as they attract their neighbors, no resultant force tending to move them in any direction. The attractions which they mutually exert across the imaginary plane constitute cohesion.

INTRINSIC PRESSURE. The mutual attractions of molecules on either side of an imaginary plane account for the observed cohesion of a substance; but if no other force existed, and the molecules were at rest, all would mutually draw together until they touched; if we assume the molecules themselves to be incompressible, total incompressibility would result. Experiment, however, shows all substances to be compressible and distensible; the force, statically considered, responsible for the maintenance of the mean molecular distance is termed 'intrinsic pressure', and for solids and liquids balances the cohesive force.

Worthington proved that to produce a given small increase in the volume of a liquid a tension must be applied equal to the compression required for a like diminution in volume; the elasticity of a liquid is therefore the same in tension as in compression. The tensile strength of water is above 11,000 atmospheres, or approaching that of steel; the cohesion of most homogeneous solids and of liquids is more or less of the same order.

Cohesive force has no direct effect upon the mobility

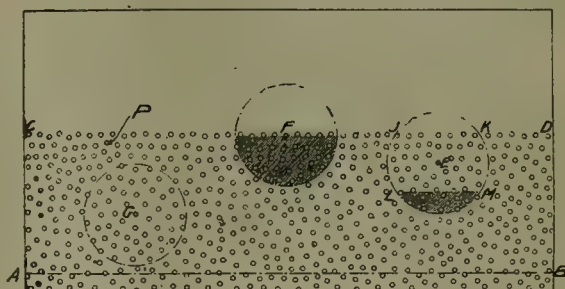


FIG. 1

of the liquid, which permits its adjustment to any configuration provided that the mean distance between its molecules is not altered. That water, in spite of its great cohesion, can be so readily divided into drops is due to mobility; the molecules under an external force such as gravity slide over each other without increase in their molecular distances, permitting, for example, water to be drawn out into a cylindrical column. When this exceeds a length equal to its circumference it becomes unstable, owing to the action of its own molecular surface forces (surface-tension) which molds it into alternate bulgings and constrictions. These develop until the constrictions become infinitely thin, when the column breaks into a series of drops.

Intrinsic pressure being equal and opposite to the cohesive force, determines the mean molecular distance for any solid or liquid; the former resists compression, the latter dilatation. Their effect may be likened to a series of uniform springs connecting the molecules which require the same force to extend as to compress them; the one is

the measure of the other, and both are manifestations of the forces which act between the molecules.

Viewed kinetically, intrinsic pressure results from the molecular collisions arising from the motion of the molecules; being perfectly elastic these lose energy thereby. When they are at their mean distances apart their total energy is potential; as they draw together this becomes kinetic, until completely so at impact. On rebound the energy becomes potential, and so on, similar to the alternations in potential and kinetic energy of a pendulum. All molecules at their interior mean-spacing are thus under equal and counterbalanced stress.

Beyond the free liquid surface there are no attracting or colliding molecules, and those in outward motion therefrom will travel on an average further than their mean-path in the interior. It follows that the average molecular spacing in the surface layers is greater than in the interior, and a state of strain is set up. As we cannot conceive of energy without strain, this is one manner of stating the origin of surface-energy; this view of diminished surface density has been maintained by van der Waals.

Wherever molecular spacing exceeds the normal for the substance (liquid or solid) strain will result; an example of the energy manifested by such areas is Mme. Curie's quartz balance, where strains in a quartz plate are produced by weights and give rise to electric charges on the foil-covered surface; or again, electric charges which result from molecular strains produced by expansion on heating crystals asymmetrically terminated ('piezo' electricity). This somewhat less dense and strained condition of the surface layers of solids and liquids has important results in adsorption, to be noted later.

When, as in gases, the forces of attraction are very small, cohesion becomes negligible, and the pressure due to the velocity of the molecules is no longer counterbalanced. One cubic centimetre of water becomes 1700 cc. of steam when evaporated at 100°C., hence the molecules in the steam must be $\sqrt[3]{1700}$ the distance apart, or about 12 times greater than they occupied in the liquid form. If the intermolecular distance be reduced by strong compression, gases show deviations from Boyle's law, especially when approaching their liquefying point, due to their molecular attractions now becoming sensible.

Since the mean distance between the molecules of a gas is large in comparison with their diameter, their mutual attractions being negligible, the actual volume of the molecules will be small in relation to that of the space through which they are distributed.

If we suppose a cylinder fitted with a piston to contain one gramme of a gas of the above constitution, the continued bombardment of the piston by the moving molecules will tend to force it outward, and the force exerted on the piston will be proportional, (1) to the number of molecules contained in unit-volume of the gas, (2) to the square of the velocity of the molecules, and (3) to the mass of each molecule. The number of molecules per unit-volume of the gas is proportional to the density of

the gas, or inversely proportional to the volume, v , of 1 gm. of the gas; it is assumed that the square of the velocity of the molecules is proportional to the absolute temperature T of the gas. Thus, if p denotes the pressure, or force per unit-area exerted by the gas on the piston,

$$p = \frac{RT}{v} \text{ or } p v = RT,$$

where R is a constant independent of the density and temperature of the gas.

The law derived experimentally by Boyle states that at a constant temperature the pressure of a given mass of gas is inversely proportional to its volume, or that $p v$ is constant; the same result is obtained by making T constant in the above equation. Since T is proportional to the square of the velocity of the molecules, it would be equal to zero if the molecules were absolutely quiescent; the temperature at which this happens is called the 'absolute zero of temperature', and is 273°C. below the freezing-point of water. Thus T , measured from the absolute zero, is obtained by adding 273° to the Centigrade temperature.

In accordance with Avogadro's hypothesis, equal numbers of molecules are contained in equal volumes of different gases at one and the same temperature. Further it has been deduced theoretically by Maxwell, and confirmed experimentally by Perrin, that at a given temperature a molecule of any gas will possess a definite amount of kinetic energy in virtue of its linear motion, this value being independent of the chemical nature of the gas. The force exerted by the impact and rebound of a molecule is proportional to the product of half the mass and the square of the velocity of the molecule, that is, to the kinetic energy due to its linear velocity; since the latter has a value independent of the chemical nature of the gas, it follows that at a given temperature the impact and rebound of a molecule, whatever may be its nature, will exert the same force, whether it be a molecule of hydrogen or one of oxygen, nitrogen, water, or alcohol.

If two cylinders contain equal volumes of different gases at equal temperatures, the number of molecules being the same in both, and the force derived from the impact and rebound of a molecule the same, the pressures are equal, and the product $p v$ will be the same in both cases.

If, instead of equal volumes, equal masses of the two gases are considered, their volumes will be inversely proportional to their molecular weights; for if, respectively, M_1 and N_1 denote the molecular weight and number of molecules in a gramme of the one gas, and M_2 and N_2 in the other, the total mass of gas being 1 gm. in either case,

$$N_1 M_1 = N_2 M_2, \text{ and } \frac{N_1}{N_2} = \frac{M_2}{M_1}, \text{ the equation } p v = \frac{8.4 \times 10^7}{M}$$

T is found to represent the relation between the pressure, volume, and temperature of 1 gm. of any gas of molecular weight M . The quantity $\frac{8.4 \times 10^7}{M}$, generally denoted by R , is called the 'gas constant' of the substance; it is numerically equal to the external work, in ergs, that would be done, as against a movable piston, if a gramme

of the gas were heated through 1°C. under the condition of constant pressure.

In extending this reasoning to liquids it is necessary to allow for (a) the attractive force exerted between neighboring molecules, which are now very much closer together; and (b) the finite size of the molecules. As we have seen, the molecules within a certain small distance on one side of an imaginary plane described in the liquid, attract those within an equal distance upon the other side of it, the attractive forces exerted across 1 sq. cm. of the plane being the cohesion of the liquid. If the density of the liquid be doubled, the number of attracted molecules on one side of the plane and the number of attracting molecules on the other side, are simultaneously doubled, the cohesion being increased four times. Cohesion is therefore proportional to the square of the density, or proportional to the square of the volume of 1 gm. of the liquid; it may therefore be represented by

$\frac{a}{v^2}$ where a is constant for a given substance.

To take into account the finite size of the molecules it is clear from the equation of $p = \frac{RT}{v-b}$ that for any finite value of T the pressure can only become infinite when the volume v is reduced to zero. This of course would be possible if the molecules were infinitely small, as they could only come into contact when the volume was reduced indefinitely. If the molecules are of finite size, they will come into contact when the liquid is reduced to some small volume which may be denoted by b ; if the molecules are supposed to be incompressible individually, the pressure must become infinitely great when they are in contact; this condition is complied with if the pressure is equal to $\frac{RT}{v-b}$ instead of $\frac{RT}{v}$.

We can now express the effects both of the cohesion and the finite size of the molecules. Let p denote the pressure exerted on the piston from without; this will tend to compress the liquid. The cohesion $\frac{a}{v^2}$ also tends to reduce the volume of the liquid. Thus the resultant force per unit-area tending to produce compression is equal to $(p + \frac{a}{v^2})$. The internal pressure, due to the bombardment of the piston by the moving molecules, is equal to $\frac{RT}{v-b}$, which tends to press the piston outward and therefore to make the liquid expand. The term 'intrinsic pressure' is generally applied to $\frac{RT}{v-b}$. For equilibrium to exist,

$$(p + \frac{a}{v^2}) = \frac{RT}{v-b}, \text{ or } (p + \frac{a}{v^2})(v-b) = RT,$$

which is van der Waals' equation, applicable not only to gases but to liquids also.

The following table gives the values of the cohesion $\frac{a}{v^2}$ for some liquids; it will be observed that the cohesion, at ordinary temperatures, is generally greater than 10^9

dynes per square centimetre, or 1000 atmospheres. Therefore for pressures in the neighborhood of one atmosphere³ p may be neglected in comparison with $\frac{a}{v^2}$, so that, to a close approximation,

$$\frac{a}{v^2} = \frac{RT}{v-b}$$

or the cohesion is equal to the intrinsic pressure.

Substance	Molecular weight	Temperature	Cohesion, $\frac{a}{v^2}$ in dynes/cm ²
Hydrogen (liquid)	2.016	-252°C.	3.09×10^6
Argon (liquid)	39.9	-183°C.	1.21×10^9
Oxygen (liquid)	32.0	-188°C.	2.40×10^9
Water	18.08	20°C.	1.23×10^{10}
Pentane	72.1	30°C.	9.00×10^9
Ether	74.1	0°C.	1.11×10^9
Mercury .....	...	0°C.	3.55×10^{10}
Ethyl alcohol	46.05	0°C.	3.33×10^{10}
Sodium chloride (fused)	58.5	803°C.	1.148×10^{10}

As the temperature is raised, the expansion of the liquid causes v to increase; the cohesion $\frac{a}{v^2}$ will therefore diminish. Above the critical temperature the cohesion can no longer hold the molecules together in the form of a liquid, and the substance can only exist in the form of gas.

When the temperature is sufficiently high $\frac{a}{v^2}$ may be neglected in comparison with p , and b may be neglected in comparison with v ; so that the equation $p v = RT$ may then be applied without sensible error.

SURFACE-ENERGY AND SURFACE-TENSION

Molecules in the surface layer of a liquid differ from those in the interior by being subject to a resultant force attracting them toward the interior. Let E (Fig. 1) be a molecule in a layer near the surface, and let the dotted circle represent its radius of molecular attraction.

The molecule E will attract all other molecules within this range, according to an inverse power of their distance from it: at the circumference of the circle its attraction becomes negligible. All other molecules surrounding it will act upon it in like manner. But its radius of attraction cuts the surface at JK , beyond which there are no reciprocally attracting molecules. Within the segment of the sphere $JKLM$ the attractions between the contained molecules and E are balanced, but an overplus of attractive force remains, namely, that exerted by the molecules in the interior represented by the shaded segment below LM and equal in amount to the attractive forces missing from the segment above JK . There is therefore a resultant pull toward the interior upon the molecule E .

On the molecule F a greater internal resultant acts, since there are no counterbalancing attractions above it. The attraction toward the interior thus increases as a molecule approaches the surface, and there reaches its maximum. If a molecule be moved from the interior to the surface, work must be done against the resultant attractions; hence on reaching the surface it will possess potential energy in excess of that which it possessed in

³An atmosphere, 76 cm. mercury at 0°C. = about 1.033 kg. or 1,013,250 dynes per sq. cm.

the interior, just as a weight raised against gravity acquires potential energy.

The foregoing can be regarded only as the simplest possible statement of the molecular theory accounting for surface energy; its further development necessarily becomes more complex. Thus the unwieldy molecules of albumen, tannic acid, or soap, containing hundreds of atoms arranged in complex molecular groups, will differ greatly in mass, configuration, and resultant attractive force from a comparatively simple molecule like alcohol, and the nature of the resultant attractions of such an assemblage of molecules can scarcely be conjectured.

Neither can the simpler types of molecule be supposed to possess invariable or like configurations, or to exert uniform attractions in all directions. Probably each has its characteristic axes: differences in the polarity (or like orientation) of a mass of molecules account for the variation in physical properties shown by unlike faces or cleavage-planes of the same crystal.

Even water itself may not consist simply of molecules of H_2O , but of 'associated' molecules, $2(H_2O)$, $3(H_2O)$, and possibly yet more complex 'hydrones'; Tammann has shown that water on freezing can be made to yield ice fractions of differing properties, regarded as the congelations in differing proportions of such associated molecular groupings.

As all molecules in a surface layer possess more energy than those in the interior, the total potential energy in a unit-area of surface is termed the 'surface-energy' of the substance; and because any system always tends to arrange itself so that its potential energy is at the minimum for the circumstances, the free surface bounding a liquid will be such that its area is minimum. The chief exhibition of this surface-energy of a liquid is the phenomenon of surface-tension which acts as if the liquid were enclosed by a uniformly contractile film. This, in satisfying the condition of minimum energy, or surface, causes falling drops of liquid to assume the spherical form. It is manifested by the resistance of a liquid surface to rupture; by the force such a surface when anchored against enclosing walls exerts in supporting a thin column of its own liquid, or 'capillarity'; by the mechanism whereby comparatively weighty particles are suspended at a liquid surface; by adsorption, and other effects.

Since surface-tension strain results from the unbalanced forces existing at the surface, it must be in some fundamental relation to the magnitude of the internal balanced forces or stresses; that is, to the cohesion or intrinsic pressure of the substance. This relationship is proved to exist; substances which have low compressibility, that is, high intrinsic pressure, possess high surface-tension and the reverse.

Liquid	Surface-tension in dynes/cm.	Coefficient of ⁴ compressibility in dynes
Mercury	440	3.83×10^6
Water	75	48 "
Glycerine	65	52 "
Benzine	28	92 "
Alcohol	21.6	105 "
Acetic acid	23	88 "
Ether	16	190 "

⁴'Surface-Tension and Surface-Energy', Willows and Hatcheschek.

The compressibility of metals and solids is lower than for liquids.

The contractile forces due to surface-tension may be visualized by dusting a water-surface with lycopodium (which rests upon it without being wetted) and then touching the water with a trace of some liquid of lower tension such as alcohol, oil, or even the greased finger tip; the lycopodium will flash away in all directions from the point of contact, as the higher-tensioned water surface pulls out the less resistant contaminated film of lower tension.

Surface-tension differs from the tension of a film of india rubber, since the latter increases by stretching, whereas that of a pure liquid remains constant and cannot be increased by stretching. The molecules retain their original spacing at the surface; increasing the area merely results in bringing more molecules from the interior to satisfy the enlargement of the surface; these then take up the spacing common to the other surface molecules.

Surface-tension (represented by σ) is therefore definable:

1. As the energy expressed in ergs required to create a fresh surface of 1 sq. cm. (unit-area); this for water is 75.8 ergs. Alternatively:

2. As the force equal to the total molecular attraction exerted across a line of 1 cm. in length on the free liquid surface; for water at 0°C. 75.8 dynes per cm. Gravity being 981 dynes per gramme, at London, the dyne is roughly equivalent to the weight of a milligramme.

Surface-tension is not equal to the total energy of the unit surface, since in the creation of a fresh surface heat is also absorbed. If the new unit-surface is to maintain the original temperature (the 'isothermal' condition), heat energy enters the surface and is stored there. A newly-formed surface of water of 1 sq. cm. absorbs heat equivalent to 41.5 ergs; hence the total surface energy of water at 0°C. is equal to 117.3 ergs per sq. cm. If the surface be enlarged 'adiabatically' (where no heat enters or leaves the water) the liquid will be cooled.

Surface-energy cannot be regarded as completely concentrated at the immediate surface; it reaches its highest value there, and becomes inappreciable at a depth probably equal to the molecular range of attraction for the particular liquid; below this distance the molecular constitution of the liquid will be that of its general interior mass. It is within the surface layer that certain molecules or particles foreign to the pure liquid tend to be concentrated; such will reach their greatest concentration at the actual surface. This process of surface-concentration is known as 'adsorption'.

Among liquids, mercury and the molten metals have the greatest surface-tension, a fact of interest when considering the probable magnitude of their solid surface-tensions.

The surface-tension of a liquid can be accurately measured by weighing the pull exerted by a film of the liquid.⁵ The method of capillary height gives a true figure only

⁵See 'General Physics for Students', E. Edser.

when the liquid completely wets the walls of the capillary tube (contact angle = 0°), a condition not always obtainable.

Approximate surface-tensions of some other liquids against air:

	Dynes/cm.		Dynes/cm.
Molten copper	1178	Phenol (41°C.)	37.0
" gold	1018	Cresol	34.8
" silver	858	Olive-oil	32.0
" zinc	707	Petroleum	27.7
" aluminum	520	Pinene (terebene)	25.9
" tin	480	Turpentine	25.6
" lead	424	Chloroform	26.6
" bismuth	346	Acetone	23.0
" antimony	274		

MODIFICATION OF SURFACE-TENSION

a. Surface-tension decreases with rise in temperature, and disappears at the critical point of the liquid, when the surface of the liquid becomes merged in its gas.

For water at 0°C ., $\sigma = 75.8$ dynes/cm.; for each degree centigrade rise in temperature the tension decreases by 0.152 dyne/cm.; hence for any temperature the tension will be $\sigma - 0.152 \times t^\circ$.

b. Surface-tension is influenced by the curvature of the surface, its value becoming somewhat less for a concave surface (an air-bubble in water) or for a convex surface (a drop) than at a plane surface. It is however only when the radius of curvature is very small that the surface-tension is diminished perceptibly.

PRESSURE IN BUBBLES

Owing to surface-tension, a liquid surface tends to contract; and if the surface is curved, a pressure acting toward the centre of curvature will be produced. Surface-tension in the water-film surrounding an air-bubble therefore increases the pressure on the air until this reaches equilibrium with the compressive force; hence the air contained in a bubble is always at a pressure higher than that of the surrounding atmosphere. The sharper the curvature the greater will be the compressive effect, the excess pressure, P , being inversely proportioned to the radius of the bubble. For a submerged bubble (neglecting pressure due to hydraulic head) $P = \frac{\sigma \times 2}{r}$; for a bubble in air, the walls of which has two surfaces,

$$P = \frac{\sigma \times 4}{r}.$$

As the diminution in the value of σ also due to curvature is of a much smaller order than the increase in pressure due to curvature, very considerable compressions are reached in small gas bubbles. In one of 0.001 mm. radius, which will rise through water at about 1 mm. per second, the air is at an excess pressure of about one atmosphere.

c. The surface-tension of a liquid is profoundly modified by adsorption.

Pure water will not form a persistent air-bubble, nor a froth. Indeed a stable film, and therefore a froth, cannot be produced from any pure or homogeneous liquid whether water, alcohol, ether, etc.; this will require further mention under 'adsorption'.

d. An electric field normal to the surface of a liquid

diminishes surface-tension, since the tension of the lines of electrical force acting outward across the air/liquid surface diminishes the resultant of the unbalanced molecular forces which act toward the interior of the liquid; such electrical effects however appear to be negligible in flotation practice.

(To be continued)

Graphite in Madagascar

Producers of graphite in Madagascar have taken heed of the demand for a higher grade and have directed their energies toward improvement in quality rather than increase in quantity, according to R. B. Ladoo, of the U. S. Bureau of Mines. The decrease in demand since the close of the War has made this step both necessary and expedient. Recent analyses at Tananarive show 87 to 90% of carbon, and even 93 to 95% is reported by some companies, in contrast to an average of 80 to 82% in 1916-17. Most of the small mines have been compelled to close down on account of lack of demand and lack of shipping space, while the larger companies have continued, but on a greatly reduced scale. It seems probable that at the present rate the 1919 production will not exceed 6000 tons. Labor conditions are reported difficult and transportation facilities inadequate, so that even with an increased demand maximum production could not be quickly attained.

As there are no refining mills in Madagascar, graphite is shipped practically as mined. Thus a statement of shipments by grades is impossible. From statistics available it would seem that but one shipment was made in the first six months of 1919. This was 28 tons from the port of Tamatave, shipped to France in the second quarter.

In July 1919 it was estimated that the following stocks were held by producers and exporters in Madagascar:

Grade (per cent carbon)	Tons
78-80	5500
80-83	8250
83-87	8250
87-90	3300
Above 90	2200
Total	27,500

Prices quoted in July 1919 for 90% carbon, f.o.b. ship, Tamatave, averaged \$0.048 per pound. The American graphite industry at present need expect no large imports of Madagascar graphite. The Morgan crucible interests, formerly the largest buyers of Madagascar flake, have cancelled all their contracts with the miners. The French demand has been greatly reduced and Madagascar shippers do not feel that at present prices they can compete with Mexican graphite in the United States markets. The imports of graphite for September 1919 show a very large increase over those of the same month in 1918, and the indications are that the total imports for 1919 will be 50% higher than in 1918. The following figures are based upon reports from the Bureau of Foreign and Domestic Commerce:

	Tons	Value	Value per pound
September 1918	1095	\$192,753	\$0.088
September 1919	8322	1,127,449	0.068

Imprisoned Underground

By GEORGE HUSTON

To be imprisoned for over two weeks in the cross-cut by a cave underground and to be rescued unhurt was the remarkable experience of two miners, Peter Grant and Emil Sayko. The accident occurred at 10:45 a.m., November 15, in the Gold Hunter mine, situated on the outskirts of Mullan, Idaho, in the Coeur d'Alene region. Both men had families in the town.

The cave happened in what is known as the northwest stope, an extension of the Ryan stope. The old Ryan workings had caved in 1913, being filled thereby to the 33rd floor, leaving an opening between the top of the debris and the roof. The roof had not been penetrated,

nearly vertical or slightly south. The practice was to timber close to the stopes, to hold the slabby walls apart, then fill for safety, afterward. In this case, the extension stope, consisting of 35 floors, had been filled from the 3rd to the 22nd, excepting three 6-ft. sets that were used for a man-way, timber-slide, and chutes. From the 28th floor up, it was only a raise. The 48-ft. prospect cross-cut in which the men took refuge was on the 26th floor. From the third floor down to the tunnel-level the stope was supported on stulls, and as no stoping had been done below the tunnel-level, the stilled ground was not damaged by the cave.



Norris

Nelson

THE SOUP-KITCHEN FOR THE IMPRISONED MEN. NOTE THE 5-GAL. OIL-CAN USED FOR A KETTLE, THE TORCHES FOR HEATING, AND THE BOX OF BREAD.



Waldron, Vaughn, Lockhart, Nelson, Farrar

THE DIAMOND-DRILL BORING THE SECOND HOLE TO THE TRAPPED MEN; THE PIPE WITH RAG TIED TO IT IS THE ONE THROUGH WHICH THE MEN WERE FED.

60 ft. of solid rock intervening between it and the old level above. The extension stope had not been worked for several months, and the two men were cleaning up preparatory to taking a contract for a raise through. They had finished, and were descending, when Sayko noticed a crack on one of the walls. Becoming alarmed, he climbed a few floors for his carbide and water. On descending again, he had a slight argument and prevailed on Grant to go back for his lunch-bucket. The delays undoubtedly saved the men's lives, for on descending a few floors more, a cap snapped in front of them. They then made all haste to reach a 48th foot-wall prospect cross-cut, barely entering it in advance of the cave, which was thundering behind them.

The Hunter lode is in a wide zone of fissuring, shearing, and sheeting, which crosses the strike of the thin-bedded Wallace formation. The dip of the fissuring is

What caused the cave was the slipping down of a huge wedge-shaped slab running parallel to the length of the stope, adjacent to the timber, and extending down to the eighth floor; the bottom lodged against the filling, while the top fell over and smashed the upper timbering of the stopes, the subsequent movement effectually sealing all the connecting openings.

Every means was tried to reach the men through old workings, but these were found to be blocked. An incline-raise from a safe floor was started toward the west end, where the extension stope was known to be narrowest, but it became apparent soon that all the chutes were closed and that no openings existed. Efforts were then concentrated on getting up through the muck-pile to the top by the quickest route. The rescue-crew knew the men were alive from faint rappings and the smell of wood-smoke resulting from their efforts to keep warm.

At this juncture the Bureau of Mines at Washington was asked for the use of the new device, the geophone, for locating noises incidental to operations of this nature. The Bureau responded at once, directing two experts at widely separated points to report at Mullan, and the apparatus and men arrived as fast as the railway could bring them. In the meantime the men had been reached by a drill-hole, but the mere fact of the ready acquiescence of the Bureau and the sending of some of their best talent gave a high degree of encouragement to the hard-pushed crew and management.

After working six days on the raise, reaching about the 24th floor, through the muck-pile, the whole mass started to move, closing the mouth and other portions of the rescue-raise, imprisoning two men, Jack Delmarh and James Collins of the rescue-crew.

It was hardly thought possible, in view of the movement of big slabs of rock and fine material, to find Delmarh and Collins alive, so a feverish search for the bodies began. After six hours of strenuous work the men were heard talking. They were removed unhurt, after 15 hours imprisonment.

But the settling left the search for Grant and Sayko where it had started, it being evident that raising through the muck was too dangerous and slow, and that the men would perish before being found.

A raise was started immediately in solid rock at the west end of the stope, utilizing the latter to break against, and spiling against the muck. This method favored safety and speed, but the distance was nearly one hundred feet, and some coincident operation had to be carried on to sustain life in the men, who had now been imprisoned for six days.

There being a 1½-in. diamond-drill outfit on the ground, the Diamond Drill Contracting Co. of Spokane was called by telephone to furnish a crew, which arrived on the next train. A hastily improvised hoist lowered the outfit to the top of the 60 ft. of solid rock capping the Ryan stope, and on November 21 at 8 p.m. drilling was started, the 60 ft. of drilling being completed in 15 hours.

The drill-crew and management were ignorant of the exact position of the imprisoned men. To avoid end-projections of the stope and filling, the hole was drilled vertically into the Ryan stope, instead of on an incline to reach the cross-cut. When near the bottom the hole lost its water, the seepage attracting the attention of the imprisoned miners. They scrambled in the direction of the seepage with a lunch-bucket, catching the first drink that they had had for four days. After breaking through, the drillers lowered a half-inch galvanized pipe, which struck Grant on the head. The overjoyed man shook the pipe vigorously, conveying the information to those above that their efforts had not been in vain. A whistle had been attached to call the men, and after its removal communication was opened up.

One of the first things for which they asked was light, so a wire was passed down outside the pipe, with a two candle-power bulb, taking current from a storage-battery. The pipe, after being warmed by flushing with

hot water, served to convey soup, stimulant, milk, etc. The company's physician prescribed the diet, and the hungry men were made as comfortable as possible. Meanwhile another hole was drilled and reamed out to two inches. Through this, elongated loaves of bread wrapped in paraffined paper were passed and suitable receptacles filled with finely chopped fruit, vegetables, and meats were forced.

On account of the danger from further caving, a two weeks stock of provisions, candles, and other things was lowered and conveyed to the cross-cut; also the ½-in. pipe was extended and the men were instructed to stay there until rescued. With plenty to eat and drink, and means of warmth, the question of sustenance was solved.

Meanwhile the work of raising went on with strenuous energy, day and night, until on November 29 at 3 p.m. the men were removed, after being confined for 14 days and 4 hours in their underground prison.

It is pleasing to record that the resources of the entire district were placed at the disposal of the Gold Hunter management. With characteristic brotherly feeling, the workers engaged in the rescue gave of themselves freely and without stint. The rescued men, after having their eyes bandaged, were conveyed to the hospital at Wallace. They were in good condition, and thanks to their pluck and powers of endurance, will soon be out in good health. Their faithful wives, who sustained the men's courage after communication was opened, are the happiest of women, never losing their faith in the ultimate rescue.

WHAT IS A NUISANCE? "That's the greatest nuisance that ever came out of Mexico," said a Texas rancher several years ago, with a sweep of his arm. Many nuisances have come out of Mexico, including boll weevil and Villa, but what the rancher referred to as the greatest of them all was the *candelilla*, a rank weed covering northern Mexico and millions of acres of southern Texas. The cattle-men would rather see good grass growing, on which steers might fatten, but this weed defies extermination. Cut it off at the roots, and the next year its growth is as luxuriant as ever. Perhaps Modern Industry heard the rancher's remark, for one day she summoned her handmaiden, Chemistry, and commanded her to find the Creator's purpose in placing the weed there in such abundance. After patient research, Chemistry placed in the hands of her mistress a little cake of hard wax almost equal to the carnuba made from the wax palms of Brazil, and worth about \$500 per ton. Its earliest use was for varnish, floor-wax, and candles; but now the making of phonograph records claims an increasing share of it. As the cost of manufacture from the *candelilla* is not large, Modern Industry asks, "What is a Nuisance?"

Selenium production in 1918, according to the U. S. G. S., was 103,694 pounds, valued at \$206,540, an increase of 162% in quantity and 195% in value as compared with figures for the previous year. Of the quantity sold during 1918 about 60% was used as a coloring and deoxidizing agent by the glass industry.

The Como Consolidated Mill

By F. BORZYNSKI

The Como Consolidated Company's property is situated in the Silver City-Palmira mining district of Lyon county, Nevada. The mine and mill are about 12 miles south-east of Dayton, the nearest railway point. The mill has been recently remodeled and enlarged to treat the ores from the Como-Eureka, North Rapidan, and Lucky Sunday mines.

The ore consists of hard quartz with small amounts of

is approximately 100 tons per 24 hours. Only about 60 tons per day is being milled now, but the management expects to run the mill to its full capacity as soon as the ball-mill is ready for operation.

The ore from the mine is dumped into a 60-ton bin. It is then reduced to one inch in a No. 3 McCully crusher and elevated by a bucket-elevator to a 75-ton bin. The crushed material is fed by two Challenge feeders to ten 1050-lb. stamps. The stamps make 110 drops per minute. Three to five-mesh discharge screens are used. The capacity is about six tons of ore per stamp per 24 hours.

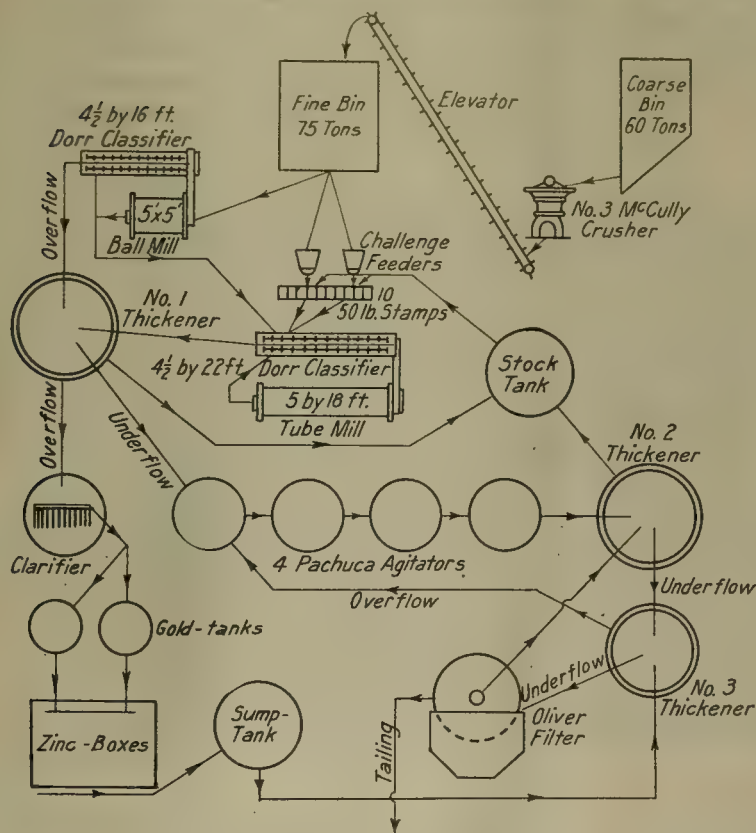
The ore fed to the 5 by 5-ft. ball-mill will be delivered from the fine-ore bin onto a 20-in. conveyor. The belt has a variable speed, so that the rate of feeding can be regulated at will. To the ball-mill is connected a 4½ by 16-ft. duplex Dorr classifier working with the ball-mill in closed circuit. The ore is to be reduced from one inch to 85% minus 200-mesh in one operation. The overflow from the classifier will join the overflow from a 4½ by 22-ft. duplex Dorr classifier working in closed circuit with a 5 by 18-ft. tube-mill, and the united overflow will be pumped by a 2-in. centrifugal pump to the No. 1 Dorr thickener.

The pebbles used in the tube-mill are made from local material. One of the mine stopes contains a large number of very hard and tough quartz boulders, which are separated at the coarse crusher and broken with a sledge-hammer to the required sizes. About 10 lb. of pebbles per ton of ore is required, and although consumption of these pebbles is high, the grinding results are satisfactory. The cost of

the pebbles is 7½ cents per ton of ore milled, and is much lower than the cost of Danish pebbles. Besides the home-made product contains about \$7 per ton that is recoverable.

The No. 1 thickener is 30 by 10 ft. and the mechanism makes 12 r.p.m. Most of the overflow is sent by gravity to a clarifier and the remaining flows to the stock-solution tank.

The clarifier-tank is 20 by 10 ft. and contains eighteen 8 by 5-ft. leaves. The leaves are connected to a 9½ by 8-in. vacuum-pump and the solution so clarified flows to



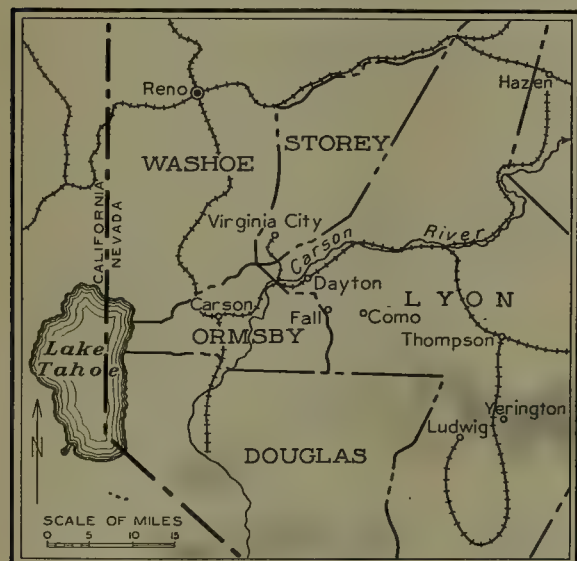
FLOW-SHEET OF COMO MILL.

calcite and other minerals. The valuable metals are gold and silver in approximately equal proportions, and both are so minutely disseminated that fine grinding is essential. The milling process consists of crushing in a gyratory machine followed by stamps and a ball-mill, both crushing in a 3½-lb. cyanide solution. The pulp from the stamps is classified and the coarse material re-ground to 85% minus 200-mesh in a tube-mill. The ball-mill will reduce the ore to the required fineness in one operation and is so arranged that it can be used as an intermediate grinder in place of the stamps. The capacity of the mill

two 10 by 10-ft. gold-tanks and from there to nine 8-compartment zinc-boxes. The zinc heads average \$1.50 per ton in gold and silver, and about 3.5 lb. of cyanide. The zinc tails flow through measuring orifices into a 20 by 8-ft. sump-tank.

The overflow from the No. 1 thickener is raised with an air-lift into four 12 by 36-ft. Pachuca agitators. The air for agitation is supplied by two 10 by 12-in. compressors at 25 lb. per square inch. The thickness of the agitated pulp is 33% solid. Cyanide is added to the No. 1 agitator, where the solution is raised to 4 lb. of cyanide per ton of solution.

The discharge from the No. 4 agitator flows to the No. 2 thickener. This is 30 by 10 ft.; here the pulp is washed by the addition of the filtrate from the Oliver filters and



MAP SHOWING POSITION OF COMO, IN NEVADA

the overflow from the No. 3 thickener. The overflow from the No. 2 thickener goes to a 20 by 10-ft. stock-solution tank, and the underflow to the No. 3 thickener for further washing and thickening.

The No. 3 thickener is 24 by 10 ft. Here the pulp is washed with barren solution from the sump-tank; the thickened overflow of about 55% solid flows by gravity to 12 by 12 ft. and 8 by 12 ft. Oliver filters where it receives final washing and dewatering. About 19 tons of fresh water is used per 24 hours, this being sufficient to replace the solution lost in the tailing. Only one filter is used at a time, the other being kept in reserve.

The consumption of cyanide is nearly 2 lb. per ton of ore. Eighty-nine hundredths of a pound is the mechanical loss, the remainder being chemical. The chemical loss is exceptionally high owing to the copper content of the ore. The amount of lime used, however, is very small, owing to the low acidity of the ore and its fast-settling rate. About one pound of lime per ton of ore is all that is required.

Charles La Kamp is the general superintendent and Mr. Warner the mill superintendent. Their combined efforts are producing good results. The milling cost, at first high, steadily diminishes, and is near the \$2 mark at the present time, which is very good for the locality and existing conditions.

THAT the personnel of the U. S. Geological Survey is facing serious deterioration is indicated by the following statement of the Director of the Survey in his annual report: "The fact that there have been 77 resignations from the scientific force of the U. S. Geological Survey during the last year—17% of the force—suggests inadequacy of compensation, and the percentage of resignations in the clerical and non-scientific force was even larger. This statement, of course, does not include separations to enter military service. The largest inroad upon the Geological Survey personnel comes from the oil companies; the final result of the pioneer work of the Federal geologists in applying geologic methods to the search for oil and gas is that a large proportion of the leading oil geologists the world over are U. S. Geological Survey graduates. Indeed, the future decline in popularity of the Geological Survey as a recruiting station for oil-company employees will be due simply to the fact that the experienced oil geologists who remain in the Government service are from personal preference immune to outside offers. The relation between Government salaries and outside salaries of geologists has been definitely determined in a compilation of the records of 29 geologists who left Government service after receiving an average salary of \$2271. The average initial salary of these men in private employ was \$5121, and after about two years of average service this compensation averaged \$7804, and eight of these geologists receive \$10,000 or more. The disparity is even greater if consideration is given to the large financial returns from investments made by the private geologists in connection with their professional work, a privilege properly denied by statute to the official geologist. That the value of these men as specialists and consulting geologists is far greater to the country at large than to private corporations is undeniable. Furthermore, it is important to note that most of these geologists had persisted to the limit of endurance with a magnificent spirit based on their love of scientific research and their desire to contribute to the sum of geologic knowledge. Most of them have been forced out of the service by sheer financial necessity. Unless adequate measures are taken to ameliorate the situation, the geologic staff is destined to suffer far greater deterioration of morale and depletion in its ablest, most responsible, most experienced, and most valuable members. The Geological Survey is passing into a stage when, with greater need than ever for systematic geologic work in the country, it is ceasing to be attractive to the young men of greatest ability, training, and promise. This situation deserves prompt and effective remedy, for it threatens most seriously to cripple this branch of the public service."

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

PHELPS DODGE POLICY OUTLINED BY NEW GENERAL MANAGER.—HIGH-GRADE ORE AT SHEA COPPER PROPERTY.

DOUGLAS.—P. G. Beckett, who became general manager for the Phelps Dodge company on January 1, believes that the copper situation is somewhat more cheerful now than 60 days ago; 18 and 18½ cents, however, is incommensurate with the present cost of production, based upon wages at 24 cents under the sliding scale and with over-

worked off and there is sufficient demand to justify us in resuming production. Similarly, at the Burro Mountain branch, Tyrone, N. M., no production will be made by the recently remodeled concentrator until the demand for copper and financial conditions justify it. At the Moctezuma Copper Co., at Nacozari, Sonora, production will be continued on a 50% basis and a few necessary improvements will be made in and about the mine. Plans are in hand for remodeling the concentrator to treat a larger tonnage with improved metallurgical results, but



THE ARIZONA DESERT IN BLOOM; THE SUPERSTITION MOUNTAINS IN THE BACKGROUND

head charges high as a result of decreased production. It will be the policy of the Phelps Dodge Corporation to maintain uniform curtailed production. Mr. Beckett says it is up to each individual, whether working with hands or head, to produce individually as much as possible. "At the Copper Queen branch at Bisbee no material change is contemplated, either underground or on the surface," said Mr. Beckett. "The smelter will continue examinations and test work now under way, but no new construction is in sight while present conditions last. At Morenci the present campaign of development work to open new orebodies will continue during the present year, but though plans for a new concentrator will be made, nothing will be decided definitely and no money expended until the present big copper surplus has been

most of this work is contemplated for the latter part of 1920 rather than at the present time." Mr. Beckett comes here to succeed A. T. Thomson, assistant to the president, who has gone to New York.

The Colford Copper Co., operating a group of claims adjoining the Swisshelm gold-silver property, 30 miles north of Douglas, is installing an experimental mill, including two Wilfey tables, a ball-mill, crusher, and a distillate engine. The company has a quantity of lead-vanadinite ore blocked out as well as some gold, silver, and lead carbonates. The operating company is an Alabama corporation, headed by Alexander Cole as president. E. A. Hemphill is manager.

TOMBSTONE.—In order to operate the Humboldt mine near Hill Top in the eastern part of Cochise county, sev-

eral Tombstone men formed a leasing company at a meeting here. The mine is 14 miles from the Southern Pacific railroad, Dos Cabezas being the nearest station. The property has been thoroughly sampled with satisfactory results. Henry Bonardiman, superintendent, is preparing to start work. There is some machinery already on the ground but it is said the equipment will be increased soon.

FLUX MINE.—The management of the Flux mine reports approximately 100,000 tons of lead-silver ore, about 60,000 of which is lead carbonate, blocked out. A winze sunk from the 160-ft. to the 260-ft. level is entirely in sulphide ore. All necessary material for a ready-fluxing smelter-charge is on the ground, including manganese, iron, lime, and silica. Nearly a mile of underground work has been completed. The ore averages from 1 to 7 oz. silver and from 11 to 18% lead per ton. There is a 100-ton flotation mill on the property, and the construction of a smelter to treat ore and concentrate is being given consideration.

JEROME.—Shea Copper Co. has almost completed the temporary ore-bins at the foot of the dump and a road has been built to give easy access to the bins. With completion of the road and bins shipments of 25 tons of high-grade silver-copper-gold ore will be made daily to the United Verde Extension smelter. Very good ore is being found in the raise from the 320-ft. level at the intersection of the east-west and north-south veins. The general average is said to be about \$250 per ton, with silver predominating. The raise at last report had been carried up almost 100 ft., practically all in ore and with no sign of a wall. Good progress is being made, according to those in charge.

TUCSON.—C. M. Taylor and associates have taken over the group of mines at Olive camp in the San Xavier district south of Tucson. These mines were originally opened in 1886 and yielded a large tonnage of silver ore. Lessees at various times have opened high-grade pockets of chloride silver and lead ore. Mr. Taylor will work part of the property and part will be leased.

YUMA.—J. M. Pryor has sold his group of five claims in the silver district 30 miles north of Yuma to Los Angeles and Salt Lake operators for \$70,000. The vein was discovered a year ago and on sinking widened to 28 in. of rich silver ore.

PATAGONIA.—J. M. Layman, owner and operator of the Blue Nose silver property, has announced his intention to organize the Arizona Patagonia Silver Mining Co. to take over this property. Development during the past seven months has opened a large tonnage of ore. The Blue Nose mine has been worked irregularly during the past 30 years and has produced some rich ore.

Shipments of 300 tons of good-grade ore are being made monthly from the Mowry mine. A large body of milling ore is being developed and it is expected that in the near future sufficient ore will be assured to warrant a mill. Since operations commenced in 1918 only virgin territory has been developed. There is known to be a large tonnage of milling ore in the old workings.

COLORADO

1919 PRODUCTION IN CRIPPLE CREEK DISTRICT.

CRIPPLE CREEK.—Production from the Cripple Creek district for 1919, curtailed first by the labor trouble and more recently by the coal shortage, is the lowest since 1895, when the camp was in its infancy. In that year the camp was credited with the production of gold ore worth \$6,100,000. In the past year the mines have produced and the mills have handled 756,000 tons of ore with an average value of \$9.82 and gross bullion value of \$7,439,719.59. In previous years the bullion value of the ore has at times exceeded \$12,000,000. January was the best month, with a production of \$735,000, while in November but 33,182 tons, with a bullion value of \$292,738, was treated.

Considering the total production the dividends distributed were satisfactory. Four companies contributed a grant total of \$2,060,000 paid stockholders. In addition to this amount, lease profits, conservatively estimated, totaled \$400,000. The companies and their dividends follow: Cresson Consolidated G. M. & M. Co., \$1,220,000; Golden Cycle M. & R. Co., \$540,000; Portland G. M. Co., \$240,000; Vindicator Consolidated G. M. Co., \$60,000.

The output of the district by months was:

Month	Tons treated	Gross bullion value
January	82,510	\$735,150.70
February	75,350	647,500.00
March	74,643	737,784.72
April	78,500	674,715.00
May	65,376	691,861.45
June	62,900	648,893.00
July	66,162	636,828.40
August	55,930	614,937.66
September	60,590	590,255.60
October	53,071	612,804.48
November	33,182	292,738.58
December	48,000	566,250.00
Total	756,214	\$7,439,719.59

MAYDAY.—E. B. Miller, superintendent of the Cumberland, recently let a contract to Graff and Rudolph to drive a 100-ft. tunnel into Snowstorm mountain on the Cumberland vein, and they have opened up a rich 4-in. streak of gray copper. The Cumberland vein, which is 3 to 5 ft. wide, has been explored in a number of places with long tunnels and open-cuts. One 1600-ft. tunnel has the vein exposed for a distance of 1200 ft. The Cumberland is among the oldest producers of the district, but has been idle for a number of years. A mill on the property, which was not a success, will be remodeled according to present plans.

Carl Bowman, who is interested in the Jumbo, has secured a sub-lease on the Little Nona from Eli Blunt and will begin operations there, it is said. The Nona claim is contiguous to the Jumbo where an orebody was recently opened. The Nona has been operated entirely by lessees and has produced approximately \$18,000.

LEADVILLE.—The Arkansas Valley smelter is operating

at 50% capacity with three blast-furnaces in service. The Leadville mines shipping to the smelter and their approximate tonnage follows: Yak tunnel, 80 cars; Down Town group, 120; Ibex, 30; Iron mine, 15; R. E. Lee, 10; Matchless, 12; Denver City, 8; Adelaide, 8; Mikado, 6; and scattered leases, 60 to 70 cars.

TELLURIDE.—For the first time in 15 years the Tomboy Gold Mines, Ltd., passed its dividend. More ore was treated than during the previous 12 months, but the realization was less. In commenting on income-tax levies, the chairman of the board at the annual meeting in Lon-



THE IDAHO MINE, NEAR MAYDAY, COLORADO

don said: "We have become liable to pay income tax in the United States, and the authorities there, recognizing that our mine is a wasting asset, in a spirit of justice, meet us very fairly, and make us an allowance on all the ore we take out. I cannot pass from this subject without contrasting the treatment we receive from our own Government in collecting income tax. It makes no allowance for anything taken out, with the result that we shall have to pay income tax not only on our profits but on the whole capital invested in the mine. The cash assets have been left almost entirely in the United States to pay for our flotation plant."

DENVER.—A call has been issued by George M. Taylor, president, and M. B. Tomblin, secretary, for the seventh annual meeting of the Colorado Metal Mining Association, to be held at the State Capitol building January 20, 21, and 22. Burdensome taxes, tariff legislation, industrial insurance, and readjustment of freight rates are some of the problems that are to be discussed. The third annual meeting of the Colorado Chapter of the American Mining Congress is to be held in conjunction with the association meeting.

NEVADA

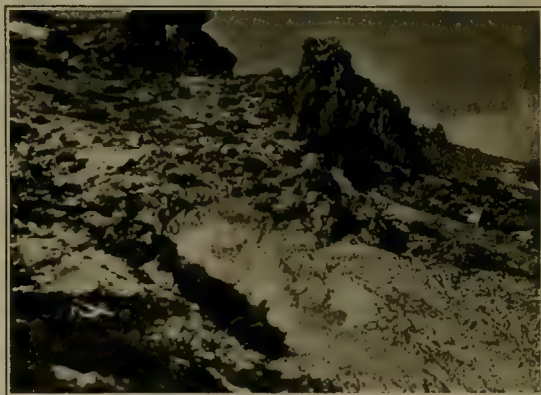
DEVELOPMENTS AT DIVIDE PROPERTIES.—MISCELLANEOUS NOTES.

DIVIDE.—In a drift being driven south from the west cross-cut to the vein, on the 200-ft. level of the Divide Extension a 4-ft. face of ore assaying \$930 has been opened, according to an official statement. Engineers now are confident that the Divide Ex. shoot will be found in the Brougher at or below a depth of 300 ft. The new shaft of the Belcher Extension has reached the 100-ft.

point, where a station is being cut preparatory to starting lateral work to determine the width of the vein and length of the ore-shoot. On the 85-ft. level of the main Belcher Extension shaft the Belcher is driving east toward the boundary line between the two. The Belcher also is driving cross-cuts north and south from its main shaft. The Victory is working at several points, the most important being north-west of the shaft on the 200-ft. level, where a drift is being driven toward the intersection of a cross vein with one striking north-east from the Butte. The Victory, Belcher, and Belcher Extension are exploring the main vein of the district as it continues north-west from the Brougher. This vein has been traced into the Thompson and Pay, north-west of the Belcher Ex. The Dividend, north of the Brougher and north and east of the Divide Extension, has drifted 125 ft. east from the No. 2 inclined shaft sunk in a vein striking east, near the intersection of this vein and the Divide Extension vein.

GOLDFIELD.—The Black Butte, in the Diamonfield part of the district, has been closed because of lack of funds until such time as the Orizaba, 35 miles north-west of Millers in Nye county, owned by the Black Butte, has been sold under an option or the option is relinquished. If the Orizaba is sold the sale will provide funds for further work and if not an assessment may be levied. Raising continues in the vein recently found on the 500-ft. level of the Red Hill, but only low-grade ore is being found. The Cracker Jack has levied assessment No. 8, at the rate of 1½c. per share, delinquent January 31.

ROUND MOUNTAIN.—The Nevada Silver Shield Mining



OUTCROP OF PRINCE VEIN, ARROWHEAD MINE, NYE COUNTY, NEVADA.

Co. has been organized to develop the Silver Shield mine in Horse canyon. According to officers of the company 200,000 tons of silver ore assaying from \$15 to \$18 has been proved in a 400-ft. tunnel reaching a depth in the vein of 160 ft. After the company has been financed it is planned to drive a second tunnel to cut the vein at from 350 to 400 ft. Springs on the eight claims owned by the company will furnish ample water for a mill. The Silver Shield Extension Co. has been organized to develop claims adjoining on the strike of the vein.

ARROWHEAD.—Raising from the east drift on the 175-ft. level of the Arrowhead has been stopped without entering the vein and drifting has been resumed. It is estimated that an additional 75 ft. will be necessary to reach the vein. Work is being done slowly, as the hoisting equipment is of limited capacity. It is reported that the terms of the sale will not permit the shipment of ore pending the making of a payment due in the near future. General conditions in the mine are said by engineers to be excellent.

WEST DIVIDE.—No work has been done in the West Divide for several weeks. L. L. Patrick, manager, is in San Francisco and it is reported that a deal for financing the company on a larger scale is pending. Mine conditions were good when work was stopped, but a tunnel was being driven in a full face of quartz, making driving extremely slow with hand-drills, and it is reported that one of the purposes of the manager's trip to San Francisco is to secure money for buying an air-compressor.

OREGON

PLACER MINING IN SIXES RIVER DISTRICT.

SIXES RIVER DISTRICT.—An important recent development in this district is the opening of placer mines by the Inman Mines Co. The company recently completed a dam on Sixes river, 35 ft. high and 135 ft. long, which will retain about 6,000,000 cu. ft. of water. A 34-in. wood-stave pipe-line has been built with a vertical fall of 147 ft., and three hydraulic giants, with 6-in. nozzles are now at work. According to the estimate of the company's engineer the project will develop 3000 hydro horsepower. The company proposes to erect an electric power plant for mining and lighting purposes. This district is situated in the northern part of Curry county and occupies the area drained by the Sixes river. The climate is mild, and the annual rainfall varies from 65 to 70 in. Snow rarely remains in the lower altitudes, while in the higher parts it may fall to a depth of 3 or 4 ft., and last for a few weeks. The rocks are predominantly shale, sandstone, and conglomerates of the Bothan and Myrtle formations, which are often intruded with basic igneous rocks. A considerable area of greenstone is found in the headwaters of the Sixes river near the Rusty and Salmon mountains, while a large area of basalt occurs in the north-central part of the district. Placer mining has been done for over thirty years, in later years leading to considerable activity in quartz mining. These placer deposits contain besides gold, some platinum and iridium. The beach sands at the mouth of the river have been successfully worked for gold and platinum for a number of years past.

UTAH

OUTLOOK FOR UTAH MINING DURING 1920.—ACTIVITY IN TINTIC DISTRICT.

SALT LAKE CITY.—The close of 1919 finds unsold domestic copper in volume probably as great as at the beginning of the year, despite the heavy curtailment in

output. It is expected that this surplus will be absorbed rapidly when foreign buying begins, as the need for the metal abroad is unquestioned. It is believed among local copper mine operators that unless unforeseen factors appear, the copper producers should be operating on substantially a normal basis before the close of 1920. The lead market has shown marked improvement lately, and it is generally conceded that silver will remain at high prices and in active demand for an indefinite period. The splendid position of silver, which broke all previous records for decades in 1919, will without doubt cause active operations in all the silver camps of the State in 1920. The metal-mining industry of the State as a whole had the least profitable year since 1915. This was due to the small demand for copper and lead and the continuation of high operating costs. The total dividends paid by the metal mines of Utah to the close of 1919 were almost \$213,000,000, more than one-half of which has been distributed in the last eight years. Nearly one-half of the above total, or slightly over \$101,000,000, has been distributed by the Utah Copper Co. alone.

ALTA.—Forty feet of ore, extending for a distance of 130 ft., is now exposed in a drift to the south of No. 8 raise in the Columbus Rexall mine, according to M. R. Evans, general manager. The ore was struck during the early part of December. An average assay shows 41.4 oz. silver, 18.9% lead, and 0.25% copper. The trend of the orebody is such as to indicate that it will eventually lead to the place where mineral was found in the old work on the Kennebec claim, and if this proves to be the case, the company will have a large area of potentially productive ground.

PARK CITY.—Not for many years has there been so much development work under way as the new year finds at the Ontario, the oldest mine in the district and one of the heaviest shippers of silver ore. At present the shaft is being sunk to the 2000-ft. level, which is 500 ft. below the drain-tunnel. There are four places on the 1700-ft. level from which ore can be mined, and it is to get under these orebodies that the work is being done on the 1800-ft. and 2000-ft. levels. On account of the high price of silver, the Ontario is today shipping material which a few years ago it would have been unprofitable to move.

Following the settlement of litigation with the Silver King Coalition, the Keystone company began operations on December 26, with Andrew Hurley in charge of the property. Ore is exposed in four places where it can be mined with but little work. The company has no hoisting or pumping operations to contend with, and the ore readily can be stoped down to the tunnel-level. It is said that the average assay of the ore exposed runs from \$75 to \$90 per ton. The directorate of the Keystone company is composed of some of the prominent business men of Salt Lake City. H. G. McMillan is president.

EUREKA.—The Tintic Winchester Mining Co. has filed articles of incorporation for the purpose of engaging in a general mining business. The officers and directors are: George F. Tilson, president; William Haws, vice-president; L. N. Ellsworth, secretary and treasurer; S.

Trotter and H. B. Cole, additional directors. Most of the mines in camp closed for several days' holiday beginning with December 25. Ore shipments from this district for the five-day period ending December 25 totaled 131 cars, of which the Tintic Standard shipped 35; Chief Consolidated, 29; Dragon Consolidated, 14; Iron Blossom, 8; Eagle & Blue Bell, 8; Mammoth, 8; Colorado, 6; Centennial Eureka, 5; Grand Central, 4; Swansen, 4; Ridge and Valley, 3; Empire, 2; Gemini, 1; Alaska, 1; and Primrose, 1. The rejuvenation of the old Sunbeam property in the south end of the district has been brought about by the advance in the price of silver, and at present this mine is shipping approximately two carloads of ore per week with prospects of heavier shipments by spring. Several months ago E. R. Higgenson took over

the East Tintic Coalition installed a modern electric hoist, and is now awaiting the arrival of a compressor, which will enable the company to speed up its development work. Fortunately the formation through which the shaft is now being sunk is quite soft and fairly good progress can be made without the use of machine-drills.

BEAVER.—In driving east on the 470-ft. level of the Beaver Copper property in the Beaver Lake mining district, six inches of ore was encountered, averaging 6% zinc, 11% lead, and 19 oz. in silver. As this is a new part of the property that has never been explored at depth, the officials in charge of operations are highly pleased. In driving to the west on the same level, it is expected that the objective will be reached shortly. This drift will tap a vein which was opened up on the 200-ft.



POWER-PLANT OF THE UTAH COPPER CO., ON GREAT SALT LAKE. MAGNA CONCENTRATOR IN BACKGROUND.

this property on a lease agreement. The shaft has been re-timbered and tunnels on the 100 and 200-ft. levels have been cleared out. It is from these two levels that ore is being produced now. At the Iron King property in the eastern part of the district, four different headings are being driven, two on the 1000-ft. level and two on the lowest level of the new shaft, which has a depth of 1565 ft. While officials of the company say very little, the operators are encouraged with results obtained thus far. The winze in the Opohongo, which has already been sunk a distance of 75 ft. below the 1800-ft. level, in vein matter, will be continued, according to F. E. Birch, manager. In order to facilitate sinking, a small engine is now being installed near the winze. The 1800-ft. level in the Opohongo is equal to a depth of 2400 ft. in the Iron Blossom, so that the Opohongo winze is nearing a locality where an important orebody can reasonably be expected. John M. Bestelmeyer, manager of the East Tintic Coalition property, reports that at a depth of 90 ft. in the new working shaft there is now $4\frac{1}{2}$ ft. of vein matter, and as the fissures are in the lime, the officials feel highly encouraged over recent developments. A short time ago

level and which contains both sulphide and carbonate copper ore.

OPHIR.—The Ophir Metals Co. has taken over the property of the old Lion Hill company. At a meeting of the board of directors of the Ophir Metals, it was voted that the privilege extended to the stockholders of the Lion Hill Consolidated Mines Co., under date of September 15, 1919, whereby such stockholders were to be allowed to exchange their stock for certificates convertible into stock of the Ophir Metals Co. be limited to December 31, 1919. Over 50% of the old Lion Hill stockholders have assented to the plan and privilege extended to them and have made payment in full or in part of 20c. per share and have deposited their old stock with the Equitable Trust Co. of Boston.

GOLD HILL.—The Western Utah Copper Co., according to O. F. Brinton, manager, is shipping 125 tons of ore daily to the smelters, and in addition is handling 50 tons per day at its new mill recently erected to treat the low-grade ores of the district. Development work on the 700-ft. level has disclosed a vein of good milling ore for a distance of 150 ft. from which much is expected.

BRITISH COLUMBIA

SAMPLING PLANT AT PRINCE RUPERT.—VANCOUVER MANGANESE SHIPMENTS PROFITABLE.

CARIBOO.—E. E. Armstrong, who located the properties on Proserpine mountain which are being developed by Robert Bryce and associates, has formed a syndicate to develop other properties in the vicinity of Barkerville. The syndicate is capitalized at \$1,000,000. Mr. Armstrong, with others, owns property through which the belts of ore that the Bryce syndicate is developing are supposed to run.

PRINCE RUPERT.—A syndicate has been formed to build a sampling works in this city, for the purpose of buying ore from small companies that do not produce enough ore to make shipments to a smelter. The ore will be sampled and assayed, and the producers will be paid full value less brokerage, smelting, and shipping charges.

HAZELTON.—The American Smelting & Refining Co. has closed a deal with the Sunrise mine, and development operations will be started early in the year. Operations at the Skeena Mining & Milling property, on Hudson Bay mountain, have been suspended pending a meeting which has been called to discuss future plans. S. A. Davis has taken an option on the Paddy Higgins property, on Driftwood creek, and will start development operations at once. The Cassiar Crown Copper property, on Grouse mountain, is developing well. A drift has been driven on the vein for 200 ft. The vein is 26 ft. wide and assays \$35 per ton. A second tunnel is being driven to put the vein at 280 ft. The sudden thaw has caused a mud-slide in the new tunnel at the Silver Standard mine and the present tunnel has been abandoned. A new site for the tunnel has been selected, and, though it will necessitate 400 ft. additional driving, it will make a far better working tunnel.

FERNIE.—A large majority of the miners throughout district 18 have renounced the United Mine Workers of America in favor of the 'One Big Union'. The miners have accepted the 14% advance in wages, offered by the owners in conformity with the agreement between owners and employees in the United States, but they will fight any attempt to force a separation with the O. B. U. As the mine owners persistently have refused to acknowledge this union, a deadlock is likely to occur. The Crow's Nest Pass Coal Co. has increased the price of coal 34c. per ton to meet the increase in wage.

COWICHAN.—Having shipped 500 tons of manganese ore with satisfactory results, the British Columbia Manganese plant, situated on the E. & N. railway in the Cowichan district, Vancouver Island, is making arrangements for the construction of an aerial tramway. With better transportation facilities it will be possible to increase the output of the mine. The tram is expected to be in shape within two months. Meanwhile no shipments are being made because the road is in poor condition. In a letter to the owners, Guy S. Rowe, second vice-president of the Bilrowe Alloys Co., at Tacoma, expresses himself as pleased with the quality of the Vancouver

Island manganese ore. He says that this ore analyzed not lower than 48% manganese, with some cars going over 50% manganese, and that it contained no deleterious elements in sufficient quantity to interfere with the manufacture of standard 80% ferro-manganese. He hopes that the company will be in a position soon to enter into a contract to supply three cars of ore, or about 120 tons per week.

KASLO.—Word has been received of the discovery of a 5-ft. vein of high-grade silver-lead ore at the Silver Bell mine on the south fork of Kaslo creek. The vein is made up of three feet of galena and two feet of high-grade carbonate. The Silver Bell is being operated by R. F. Green and Clive Pringle, of Ottawa, under the management of W. E. Newton. The Index and Flint properties on the south fork of Kaslo creek are shipping a car of ore; the Utica at Paddy's Peak is shipping its sixth car; while the Whitewater and other properties of the district look promising. In fact, silver-mining prospects were never brighter in this part of British Columbia.

KAMLOOPS.—Diamond-drilling on the property of the Aspen Grove Amalgamated Mines, Ltd., is making good progress. About 60 ft. per day is being bored with one shift working. Three shifts will be employed soon. In the spring, or as soon as weather conditions permit, two other drilling outfits will be started on an extensive exploration and development program.

OMINECA.—Development with encouraging results has been done on the property of the Cassiar Crown Copper Co., Grouse mountain. Some time ago a tunnel was driven which tapped the vein known as the Ruby, at a depth of 80 ft. The vein was well defined and it was drifted on for 200 ft. The value of the ore went up to \$35 per ton. More recently another tunnel has been driven to tap this same formation at a depth of 280 ft. When this second tunnel has been finished and the ore proved, it is proposed to build a new plant at a point farther down the hill, where the Ruby vein outcrops, and run a drift that will give a further depth of several hundred feet.

VICTORIA.—There are data available now indicating some changes in the mine output of the Province for 1919 as previously estimated. Contrary to earlier expectations, the output of silver will be slightly in excess of that of 1918. This is accounted by the fact that the returns from the Sullivan mine, operated by the Consolidated Mining & Smelting Co. for the latter part of the year were more than was looked for, and also by reason of the accumulated production of small shippers of the Slocan district, to which insufficient attention was paid in the compilation of estimates. Gold and lead production also will be somewhat above what was estimated, although not equaling the mark established in 1918. As to gold, the explanation lies in the speeding up of the output of the Rossland mines, also operated by the Consolidated Mining & Smelting Co. of Canada. The difference in regard to lead is due to the increased activity at the Sullivan mine and to the small shippers of the Slocan district.

ONTARIO

METALLURGICAL RESEARCH.—1919 DIVIDENDS FROM COBALT, PORCUPINE, AND KIRKLAND LAKE.

TORONTO.—Some important investigations in connection with the metallurgical industries are being promoted by the Canadian Advisory Council for Scientific and Industrial Research. A grant has been made to C. W. Drury, professor at Queens University, for an investigation to determine a suitable slag for smelting ores containing vanadium, the economic extraction of which is now difficult. Assistance is also given to Prof. Stansfield of McGill University to enable him to continue researches on the reduction of iron ores with the use of gases and the electric furnace, which have been in progress for over a

COBALT.—The annual report of the Coningas shows an output of 940,267 oz. of silver, as compared with 974,264 oz. for the previous year. Combined sales of ore from the Cobalt mine and of products from the reduction plant at Thorold yielded \$3,574,456. President Leonard reported that no new discoveries of ore had been made, and that continuous operation was apparently dependent upon the capacity of the mill to work low-grade ores, and re-grind and re-treat sand tailings, which might keep the mill running for three years. A large tonnage of low-grade ore had been developed with occasional streaks of high-grade. The surplus was \$2,103,745. The Northern Customs concentrator is developing good milling ore on the Silver Cliff property and treating about 50 tons daily at its mill. The same company has started stoping on the



MOTHER LODE MILL, SHEEP CREEK DISTRICT, NELSON MINING DIVISION, B. C.

year with encouraging results. Provision has been made by the Council for 40 bursaries, studentships, and fellowships to be awarded to qualified science graduates of Canadian universities who will train for carrying on researches in connection with the development of national resources. This is nearly twice the number provided for in 1919.

DIVIDENDS BY MINING COMPANIES.—The Northern Ontario mines during 1919 paid dividends to the total amount of \$6,600,383 in addition to \$867,430 declared payable after the first of the year. There are ten companies on the list of dividend payers. The dividends declared in 1919 by six Cobalt mines totaled \$4,999,772—three at Porcupine disbursed \$2,368,042, and the Lake Shore of Kirkland Lake paid out \$100,000. The total dividend payments from the beginning of the industry to December 31 are as follows: Cobalt, \$80,780,513; Porcupine, \$15,129,126; and Kirkland Lake, \$591,125; a grand total of \$96,500,765.

second and third levels of the property recently acquired from the Chambers-Ferland and will shortly commence taking out ore. The Temiskaming is devoting attention mainly to the development of a large tonnage of milling ore and has considerably increased its scale of operations, having 16 machines at work as compared with two in the spring.

W. E. Simpson, representing the Cassel Cyanide Co. in Canada, in discussing the question of constructing light narrow-gauge railways to the outlying mining localities of Northern Ontario, stated that in a case like that of the Gowganda silver district, where a railroad built would likely become a trunk line, a narrow-gauge line might be unsatisfactory. This belief is based upon actual experience in Western Australia, where much loss and inconvenience has been caused by difficulty of linking up lines of different gauges. This phase of the situation is being drawn to the attention of the Ontario government.

Mine operating officials in Ontario are contemplating the organization of the 'Ontario Chamber of Mines'. It is proposed to make the organization completely representative of all mining activity, with branches in each of the mining centres and with one executive at a central point. It is argued that when the executive of such an organization speaks he will carry with him the support of the majority of the mine operators. The aim is to influence legislation. It is now estimated that the shoot recently opened at the Crown Reserve will yield \$140,000 in high-grade ore, besides a considerable tonnage of mill rock. The ore-shoot proved to be a faulted section of one of the veins worked in former years. A financial statement issued last month shows the Nipissing to have a surplus of \$4,463,078.

PORCUPINE.—Work on the Dome Extension at the 600-ft. level is said to have placed in sight a large tonnage of medium-grade ore. The Dome is preparing to start cross-cutting from its property into Dome Extension territory on the 1150-ft. level where diamond-drilling has indicated large lenses of ore. The Norwoods Mining Co. has discovered by diamond-drilling a 5-ft. quartz vein which the cores show to have been penetrated at a depth of 600 ft. The vein material is impregnated with sulphides and warrants further work.

MATACHEWAN.—At the Matachewan development work has been suspended and the management has undertaken exploration on an increased scale with two additional diamond-drills.

GOWGANDA.—The Castle shaft has reached the 100-ft. level, where a station will be cut and drifting undertaken. The vein retains its width and grade. The camp buildings on the Walsh property on Miller Lake are being put in shape and a comprehensive plan of development has been adopted. The property is equipped with some mining machinery and has a shaft 200 ft. deep.

SONORA

CANARIO COPPER ACTIVITIES.—EXPORTS THROUGH AGUA PRIETA.

NACOZARI.—One of the more important discoveries in recent years in this district is the big orebody opened by the Canario Copper Co., a New Jersey corporation, on the 300-ft. level of its shaft on the Lily Segundo group, five miles south-west from Nacozari and about the same distance north-west of Pilares. James P. Harvey, president and managing director of the company, following inspection of the mine stated that the drift had proved the ore for 120 ft. with the limit not yet reached and the value increasing with the progress of the work. Assays average about four per cent copper. The find encourages Mr. Harvey's belief that the orebodies will show enrichment at depth. On the upper levels large bodies of copper ore carrying an average of 2 to 2½%, have been opened. The opening of so large a body of copper ore in this part of the district, hitherto practically unexplored at depth, is important as it indicates the value of the undeveloped ground intervening between the Lily Segundo and the great low-grade copper mines of the

Moctezuma Copper Co., at Pilares. The Lily Segundo has passed the 'prospect' stage, but Mr. Harvey advises the stockholders to continue development for at least another year, before building a concentrator. The property is a close corporation, owned by George F. Shurtleff and others. Approximately 200 men are employed at present. A good wagon road connects the Canario holdings with Nacozari, its rail shipping point. The company owns motor-trucks which are used to haul supplies at the present time.

SAN JULIAN.—Because of difficulty in securing freighters the installation of the San Julian mill has been delayed considerably, but George F. Fast, manager, is here pushing work as rapidly as possible. It is his expectation that the mill will be operating by March 1 producing molybdenum and tungsten concentrates. Mr. Fast first worked the San Julian several years ago at the time of the tungsten boom. When this metal became a drug on the market, the molybdenum became valuable on account of war time demand. A great many carloads of high-grade ore were sold to the United States during the war period. Following the War mining was stopped while a series of experiments was undertaken. This resulted in the discovery that a high-grade concentrate could be made which would find a ready market. Coarse grinding will be done in a ball-mill and the pulp sent through a K. & K. flotation machine used as a rougher, with a baby machine as a cleaner. The tailing then will be sent over tables where the heavy tungsten contained in the ore is recovered as a concentrate, which is in good demand in the United States.

MINA MEXICO.—Carl P. Halter, who will be superintendent of this property, has arrived from El Paso and assumed his duties. Sam Supplee, master mechanic, is in Moctezuma receiving and re-shipping the new machinery for the property's flotation mill. A ball machine and flotation machines will be used to treat the mine dumps which contain about 60,000 tons of material. While this is in progress, pumps will be installed to unwater the mine so that operations on the lower levels can be started. Several American mechanics are on the property and with a force of 30 Mexicans are repairing and re-arranging the concentrator machinery for the new system of ore treatment to be used.

AGUA PRIETA.—A slight increase was shown in ore exported into the United States through the port of Agua Prieta during the month of December, the total being 212 carloads with a valuation of \$1,857,800, as against 197 cars valued at \$1,655,000 during November. Tonnage is smaller in December being 9099 as against 9648. The increase in value was effected through heavy shipment of concentrates. Ore shipment was somewhat hindered by the increased shipment of wood from Cos and vicinity to meet the demand occasioned by the coal shortage. The mines shipping were: Nacozari, 7820 tons; El Tigre, 540 tons; Estrella, 485 tons; Las Chispas, 41 tons; San Pablo, 38 tons; San Nicholas, 41 tons; San Luis, 81 tons; La Roy, 16 tons; San Jose, 18 tons; Santa Rita, 19 tons; Progreso, 300 lb. gold-silver precipitates.



ARIZONA

Globe.—John F. Barry, secretary of the Superior & Boston Copper Co., states: "Since striking the foot-wall vein last month on the 400-ft. level, we have shipped, from development work alone, eight carloads of ore averaging \$72 per ton, and netting a total, after deducting smelting charges, of approximately \$31,000. The north cross-cut on the 1200-ft. level, east of the Quo Vadis fault, has cut an apparently barren vein, presumably the Great Eastern. The exploration work for the Old Dominion vein is making good progress."

Jerome.—The holdings of S. S. Ballard, north-west of the old Haynes properties, embracing an area of 80 acres, has been sold to the United Verde Consolidated Copper Co. for \$60,000. This property has been under development at intervals for many years.

Kingman.—Financing of the White Star Mining Co. is under way and development of its silver property is to be commenced immediately. Machinery consisting of hoist, compressor, and other operating equipment is on the way to the property.—The famous Lagoon copper mine in the Wallapai Indian reservation which was opened to prospectors on November 1, has been located by C. H. Dunning of Prescott and is now in operation. This mine is said to be showing well.—The McCracken Silver-Lead Co. recently shipped a car of 50 tons of lead-silver ore.—The cross-cut on the 300-ft. level of the United American has not yet penetrated the hanging wall of the lode although a large quartz vein has been passed through. It is the intention of the company to sink immediately to the 500-ft. level.

Mayer.—The steel head-frame of the Arizona Binghamton in the Mayer district is half completed and re-timbering of the shaft has commenced, the working force being increased to 80 men for this purpose.—The Big Ledge Mining Co. is getting the Mayer smelter into shape to make a test run of at least 75 tons of gold-bearing ore from the Henrietta mine.—The Yaba Copper Co. has taken over the old Carroll property which has been owned by Carroll for twenty years. A shaft 250 ft. deep has developed silver ore.

Miami.—Churn-drill operations have been started by the Porphyry Consolidated Copper Co. and a diamond-drill is being installed on the 650-ft. level.—Construction work on the new mill of the Iron Cap Copper Co. is progressing favorably. The foundations and flooring are practically completed. The frame work of the mill is partly up and the grading of the narrow-gauge railroad from the mine to the mill is two-thirds completed. Drifting is being done in the new orebody recently opened on the 1000-ft. level.

CALIFORNIA

Colfax.—Dewatering of the Rising Sun mine is proceeding rapidly and the management expects to be able to develop from the lower levels soon. The pump has a capacity of 400 gal. per minute. All equipment is electrically operated.

Murphys.—Drifting on the vein recently uncovered in the lower tunnel of the Tanner quartz property is progressing with a larger working crew. The tunnel is 1300 ft. long and taps the vein 300 ft. below the old one. The vein is

three feet wide with a good grade of ore. C. W. Canfield is superintendent.

Forbestown.—San Francisco people have taken an option on the Midas gold-quartz mine on the Feather river, according to a report reaching here. The Midas has been undergoing development for several years and some excellent mill ore is exposed. Fred Bachman is owner.

Needles.—The deposit of rich gold ore found recently in the Chinoeuevis mountains by Simmons and Widrigian is attracting interest and prospectors are locating many claims. The original discovery is being prospected and is said to be showing well. The selected ore is stated to assay \$16,000 per ton, with some shipping ore exposed.

IDAHO

Coeur d'Alene.—The Polaris and Yankee Boy mining companies are planning a consolidation which is said to have already received the approval of controlling interests. Extensive development plans are to be undertaken by the consolidated company. They include a tunnel 2000 ft. long from the workings of the Yankee Boy into the Polaris ground to open the latter to a depth of 1500 ft. The Yankee Boy has a good power-plant.—Extensive development work has been commenced by the Lombardy Mining Co. at Kellogg. A cross-cut will be run 390 ft. on the tunnel-level in a north-west direction to cut the orebodies shown above. This will be followed by another cross-cut 200 ft. lower, which is expected to block out some ore.

E. C. Tousley, of Spokane, has taken a two-year bond on most of the stock of the Yankee Girl Mining Co., the price to be paid being \$60,000. The property consists of 10 claims lying south of the Polaris and Yankee Girl holdings and adjoining them. Mr. Tousley must commence work developing the property before April 12.

The East Caledonia Mining Co., the owner of property adjoining the Caledonia at Wardner, expects to resume operations soon after January 1.

MONTANA

Anaconda.—Virtually all departments at the Anaconda company's Washoe smelter, made idle by the recent coal strike, had resumed operations by January 1. This means the smelter is now being worked at 60% of its maximum capacity. The mines at Butte had been in operation since December 22.

Boulder.—The officers of the Liverpool Silver Mines Co., which is re-opening the Liverpool, one of the famous old producers in Jefferson county, report the development for a distance of 600 ft., of a 30-in. vein assaying from 40 to 90 oz. in silver. The work was done on the 750-ft. level. The district is experiencing a mild 'boom'.

MISSOURI

Joplin.—The estimated output for the district during 1919 follows: Blende, 827,651,690 lb., value \$18,128,384; calamine, 20,353,040 lb., value \$289,598; lead, 139,049,470 lb., value \$4,417,329; total value for year, \$22,835,311.

The Underwriters No. 4 mill, a new 400-ton plant recently put in operation, has been working satisfactorily, coming

up to the expectations of its owners and builders. F. N. Bendelari, general manager; Fred Carpenter, superintendent; I. L. Box, constructing engineer; and Ed. Gill, foreman of construction, are satisfied with the new plant.—The Tri-State Section, American Zinc Institute, substituted a turkey dinner for the transaction of business at the meeting held on December 23 at Picher.

NEVADA

Austin.—The International Victory company announces important ore discoveries in the Yankee Blade, near Austin, and in the claims operated at Birch Creek. In the Yankee Blade an 8-ft. vein of milling ore is exposed containing some ruby silver. J. H. Schweble is manager.—Shipping ore has been uncovered in the Diana shaft workings of the Austin Manhattan group, coming from the Morgan & Muncey vein, which is 18 in. wide.—The Cahill Lode and Bradley Divide companies, operating at Birch Creek, have discontinued sinking until heavier equipment can be put in.

Ely.—Minerals Separation North American Corporation has made another move in its litigation against Nevada Consolidated Copper Co. by filing a bill of interrogatories in the Federal Court at Portland, Maine. Armed with replies to their questions the lawyers for the plaintiff in the suit will not be obliged to ask so many details when the case comes to trial. Nevada Consolidated has been asked to describe its process of flotation, giving details as to quality and quantities of oil used. It has also been requested to show earnings of equipment and process and to supply flow-sheets. Minerals Separation asks if Nevada Consolidated uses air in its flotation process and if so how it is introduced.

Virginia City.—Importation of two carloads of provisions by the mining companies and sale at cost has reduced materially living expenses here.

Obituary

Further news has been received concerning the details of the drowning of **Reuben Edward Smith**, an American mining engineer, in Siberia. The accident was caused by the overturning of a boat in the rapids of the upper Ulya river, on the west coast of the Okhotsk Sea, on August 29, last year. Smith was a man in the prime of life, about 45 years of age, and had resided at Vladivostok and in East Siberia for a period of fifteen years. Born in the placer-fields of California, he was essentially a practical engineer of sound judgment and accomplishment. Receiving early training with his father in the construction of placer-mining plants in California and Colorado, he at the same time prepared himself in the theory of mechanical and electrical engineering. He proceeded to Vladivostok, where for several years he was in charge of coal-mining operations in the Suchan district. He was engaged extensively in the examination of gold-placer deposits in Korea and Siberia, and for the three years from 1913-'16 was in charge of important work in improving gold-mining methods at the mines of the Lenskoie company in western Siberia. Upon the entry of the United States into the War he was engaged in the service of the Consular, Military Intelligence, and War Trade departments at various points in Siberia, and performed most valuable work for the Government. He had only taken up private work again in the summer of 1919 in charge of exploration work in the Okhotsk goldfield. He leaves a wife and two children. Smith had an invaluable knowledge of the Russian language and character, and perhaps the most useful knowledge of any foreign engineer of the psychology of the East Siberian laborer. As a man he was most highly esteemed by all who knew him, and his untimely death is lamented by a wide circle of friends at Vladivostok.

C. W. P.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

R. G. Hall has returned to Burma.

J. Coggin Brown is in London on leave.

Herbert Hoover has returned to Washington.

H. Foster Bain writes from Rangoon, Burma.

C. H. Munro is at Ipoh, Federated Malay States.

L. J. Mayries has returned to India from London.

R. L. Douglass, of Fallon, Nevada, is at the Bellevue hotel.

Hunter Mann has arrived in San Francisco from Hankow, China.

Frank L. Hess and **Frederic J. Siebert** are on their way to Bolivia.

C. B. Lakenan has been at Los Angeles and San Francisco recently.

H. R. Wagner, of the A. S. & R. Co., has returned from New York to Berkeley.

E. F. Yates, formerly of the Miami Copper Co., is now city engineer of Globe, Arizona.

Reiji Kanda sailed by the 'Korea' on January 7, returning to Japan from British Columbia.

Vernon S. Rood, manager for the Utah Apex Mining Co., at Bingham, is in San Francisco.

John Morgan has become a director of the Colombian Mining & Exploration Co., London.

F. P. Mennell is engaged in geologic investigation at the Rhodesia Broken Hill mine, in Rhodesia.

M. B. Cutter, of Minneapolis, and **Clyde Heller**, of Philadelphia, were in San Francisco this week.

Dudley Inskipp is returning to London from Burma, where he has been at the Mawchi tin mine.

W. L. Brown has returned to London, and is in charge of the operations for relief in eastern Europe.

Richard A. Parker is at Duluth. He is visiting the iron and copper regions of Minnesota and Michigan.

A. J. Robin, formerly of the Mazapil Copper Co., is now with the A. S. & R. Co., at Aguascalientes, Mexico.

David Wilkinson succeeds **C. D. Leslie** as consulting engineer to the Consolidated Gold Fields of South Africa.

Stanly A. Easton, manager for the Bunker Hill & Sullivan Mining Co., is at the Claremont hotel, Berkeley, on a short visit.

M. Suzuki, manager of the Hikoshima zinc smelter, Japan, has been in Utah recently, visiting metallurgical plants and mines.

Frank H. Probert, dean of the Mining Department of the University of California, is in Arizona. He returns on January 11.

J. A. L. Gallard has resigned as mining editor of the 'Financial Times', in London, a position that he has held since 1902.

H. W. Darling, field engineer for the Crown Reserve Mining Co. of Montreal, passed through San Francisco last week on his way to Northern Ontario.

Robert H. Richards has joined in business with **Charles E. Locke**; the office of the new firm of consulting engineers will be at Cambridge, Massachusetts.

A. H. Heller has been appointed general superintendent for the Afterthought Copper Co., at Ingot, California, in succession to **D. C. Smith**, who has resigned.

William Huff Wagner has resigned his position as geologist and chief engineer for the North Butte Mining Co. to join the technical staff of the Income Tax Bureau on Mines, at Washington.

THE METAL MARKET



METAL PRICES

San Francisco January 6

Aluminum dust, cents per pound	65
Antimony, cents per pound	10.50
Copper, electrolytic, cents per pound	10.50
Lead pig, cents per pound	8.25-9.25
Platinum, pure, per ounce	\$150
Platinum, 10% iridium per ounce	\$180
Quick-silver per flask of 75 lb.	\$85
Spelter, cents per pound	10.50
Zinc dust, cents per pound	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

January 6.—Copper is quiet and strong. Lead is active and higher. Zinc is feverish and soaring.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London		Average week ending		
Date	cents	Date	pence	Nov.	Dec.	Pence
Dec. 31.....	131.00		76.00	25.....	131.93	73.46
Jan. 1 Holiday.....				Dec. 2.....	132.00	73.50
" 2.....	131.00		75.87	" 9.....	131.29	74.75
" 3.....	130.50		75.62	" 16.....	131.29	77.38
" 4 Sunday.....				" 23.....	133.56	78.08
" 5.....	130.50		76.62	" 30.....	133.50	76.87
" 6.....	131.00		76.87	Jan. 6.....	130.80	76.19
Monthly averages		Monthly averages		1917	1918	1919
Jan.	75.14	1917	101.12	July	78.92	99.62
Feb.	77.54	1918	101.12	Aug.	85.40	101.31
Mch.	72.13	1919	101.12	Sept.	100.73	101.12
Apr.	74.51		101.12	Oct.	87.38	101.12
May	74.61		101.12	Nov.	85.97	101.12
June	76.44		101.12	Dec.	85.97	101.12

COPPER

Prices of electrolytic in New York, in cents per pound.

New York		London		Average week ending		
Date	cents	Date	pence	Nov.	Dec.	Pence
Dec. 31.....	19.25		19.25	25.....	19.48	
Jan. 1 Holiday.....				Dec. 2.....	18.55	
" 2.....	19.25		19.25	" 9.....	18.21	
" 3.....	19.25		19.25	" 16.....	18.50	
" 4 Sunday.....				" 23.....	18.75	
" 5.....	19.25		19.25	" 30.....	18.92	
" 6.....	19.25		19.25	Jan. 6.....	19.25	
Monthly averages		Monthly averages		1917	1918	1919
Jan.	29.53	1917	20.43	July	29.67	26.00
Feb.	34.57	1918	17.34	Aug.	27.42	26.00
Mch.	38.00	1919	15.05	Sept.	25.11	26.00
Apr.	33.16		15.23	Oct.	23.50	26.00
May	31.69		15.91	Nov.	23.50	26.00
June	32.67		15.73	Dec.	23.50	26.00

LEAD

Lead is quoted in cents per pound. New York delivery.

New York		London		Average week ending		
Date	cents	Date	pence	Nov.	Dec.	Pence
Dec. 31.....	7.75		7.75	25.....	6.75	
Jan. 1 Holiday.....				Dec. 2.....	6.75	
" 2.....	7.75		7.75	" 9.....	6.82	
" 3.....	8.00		8.00	" 16.....	6.99	
" 4 Sunday.....				" 23.....	7.25	
" 5.....	8.25		8.25	" 30.....	7.53	
" 6.....	8.50		8.50	Jan. 6.....	8.05	
Monthly averages		Monthly averages		1917	1918	1919
Jan.	7.64	1917	5.60	July	10.93	8.03
Feb.	9.10	1918	5.13	Aug.	10.75	8.05
Mch.	10.07	1919	5.24	Sept.	9.97	8.05
Apr.	9.38		5.05	Oct.	8.97	8.05
May	10.29		5.04	Nov.	8.97	8.05
June	11.74		5.32	Dec.	6.49	6.90

TIN

Prices in New York, in cents per pound:

New York		London		Average week ending		
Date	cents	Date	pence	Nov.	Dec.	Pence
Dec. 31.....	11.1		11.1	25.....	11.1	
Jan. 1 Holiday.....				Dec. 2.....	11.1	
" 2.....	11.1		11.1	" 9.....	11.1	
" 3.....	11.1		11.1	" 16.....	11.1	
" 4 Sunday.....				" 23.....	11.1	
" 5.....	11.1		11.1	" 30.....	11.1	
" 6.....	11.1		11.1	Jan. 6.....	11.1	
Monthly averages		Monthly averages		1917	1918	1919
Jan.	44.10	1917	71.50	July	62.60	69.00
Feb.	51.47	1918	72.44	Aug.	62.53	69.00
Mch.	54.27	1919	72.50	Sept.	61.54	69.00
Apr.	55.63		72.50	Oct.	62.24	78.82
May	63.21		72.50	Nov.	74.18	73.67
June	61.93		71.83	Dec.	85.00	71.52

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

New York		London		Average week ending		
Date	cents	Date	pence	Nov.	Dec.	Pence
Dec. 31.....	9.35		9.35	25.....	8.16	
Jan. 1 Holiday.....				Dec. 2.....	8.31	
" 2.....	9.35		9.35	" 9.....	8.58	
" 3.....	9.35		9.35	" 16.....	8.65	
" 4 Sunday.....				" 23.....	8.66	
" 5.....	9.35		9.35	" 30.....	8.99	
" 6.....	9.70		9.70	Jan. 6.....	9.42	

Monthly averages

	1917	1918	1919		1917	1918	1919
Jan.	9.75	7.78	7.44	July	8.98	8.72	7.78
Feb.	10.45	7.07	6.71	Aug.	8.58	8.78	7.81
Mch.	10.78	7.07	6.53	Sept.	8.33	9.58	7.57
Apr.	10.20	7.04	6.49	Oct.	8.32	9.11	7.82
May	9.41	7.92	6.43	Nov.	7.70	8.75	8.12
June	9.03	7.92	6.01	Dec.	7.84	8.49	8.06

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

New York		London		Average week ending		
Date	dollars	Date	pence	Nov.	Dec.	Pence
Dec. 9.....	100.00		100.00	23.....	85.00	
" 10.....	100.00		100.00	30.....	85.00	
Monthly averages		Monthly averages		1917	1918	1919
Jan.	81.00	128.06	103.75	July	102.00	120.00
Feb.	126.25	118.00	90.00	Aug.	115.00	120.00
Mch.	113.75	112.00	72.80	Sept.	112.00	120.00
Apr.	114.50	115.00	73.12	Oct.	102.00	120.00
May	104.00	110.00	84.80	Nov.	102.50	120.00
June	85.00	112.00	94.40	Dec.	117.42	115.00

MONEY AND EXCHANGE

In the letter which the Federal Reserve Board has sent to chairmen of Federal Reserve banks advising them of the peculiar situation arising from the practice of basing interest rates on interior bank balances allowed by members of New York Clearing House, in accordance with 90-day discount rate at Federal Reserve banks, and calling for a general meeting of representative bankers from all parts of the country in Washington for discussing the matter, and possibly bringing about a modification of existing regulation, the Reserve Board has rather misrepresented the plan in operation among local clearing-house banks, according to one banker. Discussing the marking up of interest rates on deposits early last year, the Board, in its letter, said: "Finally the clearing-house banks of New York agreed to fix a rate of 2½% on bank balances payable on demand, with proviso that the interest rate would be automatically advanced or reduced ¼ of 1% with each advance or decline of ½ of 1% in the 90-day rate at the Federal Reserve Bank of New York. This rate is now 4½%, and should it be advanced at any time to 5% the rate of interest paid by New York banks for out-of-town bank balances would advance automatically to 2½%, and a 5½% rate at the New York bank would advance the interest on bank balances automatically to 3%, and so on."

To certain financiers this conveys the impression that there is no limit to the amount of interest the local banks may pay for deposits and that the higher the Federal Reserve Bank raises its discount rates, the higher will be the interest paid on deposits in New York. But local banks are restricted to pay not more than 3% on demand deposits. As a matter of fact the clearing-house banks did not fix the rate at 2½% on that occasion. The rate became 2½% by reason of amendment to the constitution effective October 1, 1918. It was stipulated that no member of the Clearing House Association or others clearing through members, should pay on any credit balance or deposit payable on demand or within 30 days, for account of any banking institution in the United States or Canada "interest at a rate in excess of 1% per annum when the then 90-day discount rate for commercial paper at the Federal Reserve Bank of New York is 2% or less, and an additional ¼ of 1% for every ½ of 1% that such discount rate of the Federal Reserve Bank shall exceed 2%, except that the maximum rate paid or agreed to be paid on any such credit balance or certificate of deposit shall not in any case be higher than 3% per annum."

It is believed that Federal Reserve banks will soon raise re-discount rates on commercial paper. Within the last few months re-discount rates on paper secured by Government war obligations have been raised twice, and these increases tended to reduce borrowings on this class of collateral. But while this was taking place a considerable expansion was going on in commercial borrowing at central institutions. For this reason, the next step to be taken by reserve authorities is expected to be an increase in re-discount rates on so-called "business paper" or bills secured by collateral other than United States war obligations.

This applies to commercial paper, bank acceptances, and trade acceptances. It is this class of paper in which unquestionably a large part of the commodity speculation is tied up. It has been pointed out by the Federal Reserve Board on several occasions that the Wall Street stock market was not solely responsible for undue speculation that has been going on, but that similar activity prevailed in all commodities the country over.

Foreign exchange quotations on January 6 are as follows:		
Sterling, dollars:	Cable	3.79½
	Demand	3.78½
Francs, cents:	Cable	9.27
	Demand	9.25
Lire, cents:	Demand	7.54
Marks, cents:		2.03

Eastern Metal Market

New York, December 31.

All the markets show decided strength and most of them are active and higher as the old year draws to an end.

Heavier demand for copper is reflected in advancing prices.

Quietness pervades the tin market but prices for spot are higher.

Supplies of lead are not equal to the heavy demand and higher values prevail.

Zinc quotations are considerably higher on better domestic, and particularly foreign, demand.

Antimony is unchanged and quiet.

IRON AND STEEL

There is more activity in the iron and steel markets at the opening of the year than is commonly the case, most of the mills carrying over into 1920 such large tonnages in certain lines, as to preclude new business for many weeks.

According to the annual review of 'The Iron Age' only nine open-hearth steel furnaces were completed in 1919 capable of producing 625,000 tons of ingots per year. Only 22 furnaces are under construction with an annual capacity of 875,000 tons. Not since 1911 have so few new furnaces been under construction. In the four years beginning January 1, 1915, no less than 14,000,000 tons was added to the country's open-hearth steel capacity by new construction. Though for several years pig-iron capacity has not kept pace with the increase in steel plants only two blast-furnaces were completed in 1919 and only four, with a total annual capacity of 700,000 tons, are now under construction. Negotiations over rail purchases involve probably 1,000,000 tons. The shortage in semi-finished steel has been emphasized by the shipment of sheet bars from the Chicago district and from Duluth to the Pittsburgh district.

The Lake Superior iron-ore trade looks for an advance in prices in 1920.

COPPER

Sellers report a much more active demand from both domestic and foreign consumers. Buying in December has been good and it is expected that in January it will be still better. The steadier foreign exchange market has also been a stabilizing factor as well as an incentive to better buying. Consumers are realizing that the 18c. price early in December was a low level. Brass makers are more interested and British and Japanese buying, as well as some from Scandinavian countries, is prominent. Electrolytic copper is quoted at from 19.25 to 19.50c., New York, for early delivery, with only one or two small sources from which it can be obtained at 19c. Lake copper is quiet and strong at 19.50c., New York, for early delivery.

TIN

The week has been very quiet and there has been little buying. The market has been dull and uninteresting. Prices for spot tin advanced almost daily in sympathy with a firmer trend in the value of the pound sterling and because also of a rapidly advancing market in London. The London market is largely a speculative one and apparently under close control. It advanced on Monday, December 27, £7 15s., or to £337 10s. per ton. Yesterday spot Straits was quoted at 59.25c., New York, an advance of almost 4c. per lb. in the week. American buyers are holding off because of present conditions although a little business has been done. Future shipments from the East are quoted nominal at around 59.50c., with some sellers asking 60c. Tin arrivals thus far this month have been 4953 tons, of which 1190 tons came in at Pacific ports. The quantity afloat is 3259 tons.

LEAD

The situation in the lead market can be completely described by the statement that supplies are not equal to demand. As a result consumers are becoming frightened and are bidding up the market on themselves. The outside market has been constantly in advance of that of the 'leading interest' which on December 26 advanced its quotation for the fourteenth time this year, or from 7.15c. to 7.30c., New York, or 6.90c. to 7.25c., St. Louis—an advance of 35 points. The outside market continues to keep ahead and today is quoted at 7.75c., New York, or 7.50c., St. Louis, with the tendency upward. The outside interests determine the price levels at present.

ZINC

The market continues to grow stronger and prices are considerably higher than for some weeks. Demand and inquiry from domestic consumers has not only expanded in the last few days, but foreign buying has taken another spurt. Part of the latter is due to better exchange, but the British buying is also accounted for by the fact that smelters over there can buy in the United States cheaper than they can produce. One estimate here is to the effect that the British cost is at least 11c. per lb. The technical position of the market is also very strong, as producers are not anxious to sell because they are comfortably sold up for the immediate future. As a result of the foregoing conditions, prime Western has advanced to 9c., St. Louis, or 9.35c., New York, for January delivery.

ANTIMONY

The market is quiet and quotations for wholesale lots for early delivery are unchanged at 9.62½c., New York, duty paid.

ALUMINUM

For wholesale lots of virgin metal, 98 to 99% pure, quotations are nominal at 32 to 33c., New York, for early delivery.

ORES

Tungsten: The market is quiet with quotations nominal at \$7 to \$15 per unit, depending on the grade of the ore and whether Chinese, Bolivian, or American. Very little activity is expected for some weeks. Quotations for ferro-tungsten are nominal at \$1 to \$1.10 per lb. of contained tungsten, with no open business reported.

Molybdenum: Quotations continue nominal in a quiet market at 75c. per lb. of MoS₃ in regular concentrates.

Manganese: Some Cuban and South American ore is reported sold at 55c. per unit, but this has not been confirmed. It is stated that American producers of ferro-manganese, outside of the 'leading interest', are short of ore and are willing to pay 60c. per unit.

Manganese-Iron Alloys: Ferro-manganese is quite scarce and higher. Some regard the situation as serious. Practically no American or British alloy is now available for the first half of 1920. Sales of 100 to 500 tons of domestic alloy have been made in the last week at \$130, delivered, about 2200 tons of British alloy has sold at \$120 and \$125, sea-board. Spiegeleisen is active and strong at \$40 to \$45, furnace, and a sale of 2500 tons for export is reported.

The price of Gulf Coast crude petroleum has recently been increased from \$1.25 to \$1.50, and it is said the price of Mexican crude at Gulf Coast ports will probably be advanced to \$1.25 per barrel. Fuel-oil consumers are speculating on the effect of these advances on the general market.

Book Reviews

Technical Methods of Ore Analysis. Eighth edition. By Albert H. Lowe. Pp. 378, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.25.

This standard work on practical laboratory methods has again been revised and enlarged. The notable additions relate to molybdenum, potassium, tungsten, and uranium and include revised methods, newly developed since the last edition appeared. These are found in the appendix. When the next edition appears we should like to see a more thorough revision, with the new material embodied in the text instead of in the appendix, and some of the less preferred schemes of analysis deleted. For the student, too many alternative plans are confusing, and especially where slight modifications have been found desirable would condensation and elimination prove advantageous. As a reliable guide to the analytical chemist the book is still valuable.

Analysis of Minerals and Ores of the Rarer Elements. By W. R. Schoeller and A. R. Powell. Pp. 234, ill., index. Charles Griffin & Co., Ltd. J. B. Lippincott Co., Philadelphia. For sale by 'Mining and Scientific Press'. Price, \$5.

This book is avowedly for analytical chemists, metallurgists, and advanced students, and to such it should be invaluable. Each of the rare elements is treated under some or all of the following heads: Minerals, Properties and Compounds, Quantitative Separation, Estimation, Detection in Ores, Determination in Ores, Impurities in Ores, Complete Analysis of Ores and Technical Methods. The book is in a way a pioneer, in that it has systematically treated the complete analysis of rare-element minerals. Some of the material is original; much is compiled from other literature. The authors welcome thorough investigation of their methods by analytical chemists, and hope to bring about adequate discussion of comparatively new work. A feature of the book is the presentation in tabular form of appropriate schemes for making a complete analysis of the common compounds of these elements. This economizes space and likewise makes the book more useful. Practically every element not given adequate treatment in the older textbooks is included in the present volume, which should be valuable to those concerned with analyses of this character.

The Petroleum Handbook. By Stephen O. Andros. Pp. 206, ill. The Shaw Publishing Co., Chicago. For sale by 'Mining and Scientific Press'. Price, \$2.

This purports to be 'a condensed book of reference on subjects pertaining to the petroleum industry', and the preface also states that little original matter is given. This latter, at least, appears to be true. While compilations are often valuable, this one apparently has been made by someone with relatively little first-hand knowledge. The result is that while the material is derived from authoritative sources and the facts given are correct, nevertheless, they are arranged in such a manner that the layman might easily get a number of wrong impressions regarding the industry. On the other hand, the treatment of any particular subject is necessarily so brief that the book will be of small value to the petroleum engineer or operator, since he can find but little that he does not already have at his fingers' ends without looking it up. The attempted scope of the book may be judged from the chapter-headings, which are: Origin, Accumulation, and Occurrence; Exploration and Drilling; Methods of Petroleum Refining; Natural Gas and Its Products; Shale-Oil Industry; Marketing of Petroleum Products; Gasoline Specifications; Inspection Laws, and Marketing Prices; Economic Utilization of Petroleum.

Recent Publications

Peat in 1918. By C. C. Osborn. II:15, U. S. Geological Survey, 1919. Pp. 26, map. From Mineral Resources of the United States, 1918—Part II.

Arsenic, Bismuth, Selenium, and Tellurium in 1918. By James M. Hill. I:9, U. S. Geological Survey, 1919. Pp. 7. From Mineral Resources of the United States, 1918—Part I.

Manganese and Manganiferous Ores in 1917. By D. F. Hewett. I:23, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1917, Part I. Pp. 32.

Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1917. Mines Report. By Charles W. Henderson. I:24, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1917, Part I. Pp. 26.

Gypsum in 1918. By Ralph W. Stone. II:12, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1918, Part II. Pp. 17.

Abstracts of Current Decisions on Mines and Mining, Reported from January to May, 1919. By J. W. Thompson. Bull. 181, Law Serial 19, U. S. Bureau of Mines, 1919. Pp. 175.

Gold, Silver, Copper, and Lead in Alaska in 1918. Mines Report. By G. C. Martin. I:6, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1918, Part I. Pp. 16.

Coal in 1917. Part B. Distribution and Consumption. by C. E. Leshner. II:35, U. S. Geological Survey, 1919. Pp. 57, table. From Mineral Resources of the United States, 1917—Part II.

California Mineral Production for 1918, With County Maps. By Walter W. Bradley. Bull. 86, California State Mining Bureau, Ferry building, San Francisco, 1919. Pp. 212, index, ill., maps.

Quicksilver in 1918. By F. L. Ransome. With a Supplementary Bibliography by Isabel P. Evans. I:7, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1918, Part I. Pp. 40.

Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1919, including Report on the Production of the Precious Metals During the Calendar Year 1918. 1919. Pp. 300, index. Cloth.

Silver, Copper, Lead, and Zinc in the Central States in 1918. Mines Report. By J. P. Dunlop and B. S. Butler. I:5, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1919, Part I. Pp. 67.

Gold, Silver, Copper, and Lead in South Dakota and Wyoming in 1918. Mines Report. By Charles W. Henderson. I:8, U. S. Geological Survey, 1919. From Mineral Resources of the United States, 1918, Part I. Pp. 10.

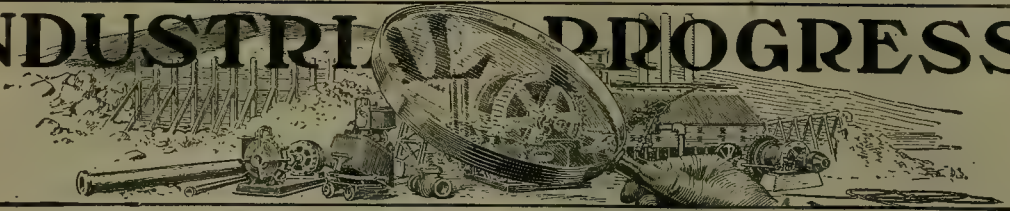
Bibliography of North American Geology for 1918 with Subject Index. By John M. Nickles. Bull. 698, U. S. Geological Survey, 1919. Pp. 148. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 10 cents.

Geologic Atlas of the United States. Herman-Morris Folio No. 210. Herman, Barrett, Chokio, and Morris Quadrangles, Minnesota. By Frederick W. Sardeson. Surveyed in co-operation with the State of Minnesota. U. S. Geological Survey, 1919. Pp. 10, maps.

Geology and Water Resources of the Gila and San Carlos Valleys in the San Carlos Indian Reservation, Arizona. By A. T. Schwenneisen. Water-Supply Paper 450-A, U. S. Geological Survey, 1919. Pp. 27, maps. From Contributions to the Hydrology of the United States, 1919.

Surface Water Supply of the United States, 1916. Part VI. Missouri River Basin. Nathan C. Grover, Chief Hydraulic Engineer. Prepared in co-operation with the States of Colorado, Montana, and Wyoming. Water-Supply Paper 436, U. S. Geological Survey, 1919. Pp. 256, ill., index.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

NEW OIL-IMMERSED SWITCH

Magnetically operated main-line switches on alternating current light and power circuits are at times slow and unreliable in closing when a solenoid and plunger must be depended upon for their operation. If the plunger is slightly out of adjustment, its movement becomes jerky and noisy,

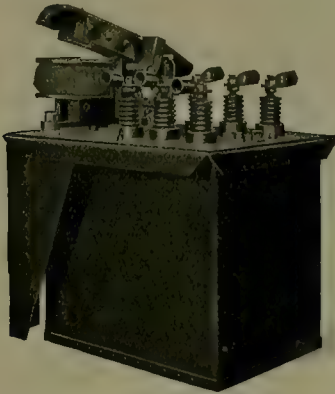


Fig. 1. New C-H Oil-Immersed Magnetic Contactor Operated by a Clapper Type Magnet and Armature, Which Increases Reliability of Operation Over the Solenoid and Plunger Type.

its sealing pull is diminished, and it does not seat properly.

The Cutler-Hammer Mfg. Co., of Milwaukee, has developed a new oil-immersed magnetic contactor, operated by a clapper-type magnet, which makes possible a more rigid mechanical structure and greater reliability in operation than



Fig. 2. Same as Fig. 1, but with Oil-Tank Removed, Showing Contacts and Arcing Shields

is obtained in contactors of the solenoid and plunger type. This contactor has a capacity of 100 amperes at 2200 volts, and is particularly desirable as a main-line switch for an automatic 2200-volt motor starter, or for the remote control of any 2200-volt light or power circuit. It is built with three

poles, unless used with an auto-transformer starter when five poles are provided.

The frame of the contactor, which is of heavy sheet iron, is arranged for wall or switchboard mounting, and carries two cast-iron supports with two insulated shafts carrying the contacts. Copper-leaf brush contacts are saved from all wear due to breaking the circuit because auxiliary arcing contacts are provided for this purpose. Leads from the contacts connect with suitable terminals extending through high-tension insulators mounted on the top of the frame. The armature is firmly pivoted to the frame, and is connected by a rod to an arm of the shaft carrying the moving contacts. The attraction of the armature against the face of the magnet rotates the shaft and closes the switch, which is normally held open by the weight of the moving parts.

A flood head of oil is maintained over the contacts by providing a sheet-metal tank of ample capacity, and as the contacts are situated above the operating shaft, they are away from any sediment which might accumulate in the bottom of the tank. The arc is broken at the contacts in a horizontal direction and therefore rises to the point of rupture without burning other parts. Transite shields prevent arcing across adjacent poles.

COMMERCIAL PARAGRAPHS

G. B. Livingood, who for the past two years has been sales engineer, has been appointed assistant manager of the mining and crushing department of the **Traylor Engineering & Manufacturing Company**.

C. F. Braum & Co. announce that they have secured for their executive and engineering offices the entire tenth floor of the Atlas building, 604 Mission street. This will bring them into closer touch with their factory. The private-exchange Douglas 1404 connecting all departments remains unchanged.

J. George Leyner announces that he has resigned as president of the J. G. o. Leyner Engineering Works Co., of Littleton, Colorado, in order to be able to devote all of his time to the **Leyner Tractor & Manufacturing Co.**, organized for the manufacture and sale of the Linapede tractor, recently developed by him. The company's office will be at 212 Tramway Bdg., Denver, Colorado.

Revised and enlarged Bulletin No. 112-B entitled 'Condensers, Pumps, Cooling Towers, Etc.' has just been published by the **Wheeler Condenser & Engineering Co.**, Carteret, New Jersey. This bulletin illustrates the latest developments in condenser practice, and shows, among others, a surface condenser containing 50,000 sq. ft. of surface. It illustrates and describes surface condensers, jet condensers, barometric condensers, the Wheeler-Edwards air pump, the Wheeler rotative dry vacuum pump, the Wheeler turbo-air pump, the patented Wheeler steam jet air pump, Wheeler centrifugal pumps for all services, jet condensers, barometric condensers, natural and forced draft cooling towers, feed-water heaters, and Wheeler evaporators and dryers. A free copy of this bulletin will be sent to responsible persons upon mentioning this publication.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JANUARY 17, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL		ARTICLES	
	Page		Page
NOTES	71	CHLORIDIZING PROCESSES	
PUBLIC SERVICE AND PUBLIC PRACTICE—II....	73	By Harai R. Layng.....	77
The Engineering professors in State Universities and their outside practice. Custom in such matters. How such practice helps them as teachers. Editors, and their custom as regards outside professional work. Dangers that arise. Professors acting as experts in lawsuits. Apex cases. A principle to guide all concerned, namely, the aim of public service.		Rapid heating necessary, especially where sodium chloride is used. Bag-houses suitable for collecting fume, as is also the Cottrell system. Degree of grinding required; methods of applying the chloridizing agent; these vary according to the nature of the ore under treatment.	
MONEY FOR EUROPE.....	74	THE HOMESTAKE FIRE OF 1919	
Mr. Hoover's statement concerning loans to the countries of Europe. His sane advice. The need for stimulating resumption of labor and the danger of pauperizing the unfortunate peoples. Cooperation in stabilizing international exchange. A straw-vote for the Presidency.		By R. G. Wayland.....	84
		Measures taken in fighting fire which started September 25, 1919. As a last resort the mine was flooded.	
		MINING AND SMELTING NEAR MATEHUALA, MEXICO	
		By R. B. Brinsmade.....	85
		A. S. & R. smelter. Purpose to make low-grade copper-matte which collects silver. Mines at La Paz. Operations at the Dolores. Mill and lead-smelter at Santa Maria. Mines at Catorce. The Concepcion mine.	
		TUNGSTEN IN CHINA	90
		Occurrence of wolframite. Methods of concentration. Marketing the product.	
		METAL PRODUCTION IN CALIFORNIA FOR 1919	
		By Charles G. Yale.....	91
		Gold. Cost of production doubled in two years. Output increased. Silver, copper, lead, and zinc production declined.	
		DEPARTMENTS	
		REVIEW OF MINING	93
		THE MINING SUMMARY	101
		PERSONAL	102
		EASTERN METAL MARKET	103
		THE METAL MARKET	104

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Office—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.

THE ANSWER TO RISING PRODUCTION COSTS

NOWADAYS most every manufacturer of metal products employs Oxywelding to some extent.

The most efficient plants are successfully meeting the problem of mounting production cost by greater and greater use of the Oxy-Acetylene Process.

Oxywelding and cutting blow-pipes make possible many a profitable short cut—proven production methods that will give you larger output at less cost.

When may we tell you about it?

OXWELD ACETYLENE COMPANY

NEWARK, N. J.

CHICAGO

LOS ANGELES

*World's Largest Maker of Equipment for
Oxywelding and Cutting Metals.*



THE annual meeting of the Institute will be held in New York on February 16 and the three following days. The papers prepared for discussion will deal chiefly with the oil industry. Mr. E. P. Mathewson is chairman of the committee on arrangements.

WE have received copies of two speeches delivered by Mr. Miles Poindexter in the Senate. These have been re-printed from the 'Congressional Record' and are mailed free as a matter of senatorial privilege. The senator from Washington is a candidate for the Presidency; he would show better taste if he desisted from advancing his candidacy at the public expense.

PEACE has been ratified, but it is a lame peace, because the United States is not a signatory. On January 16 the League of Nations comes into being, but not for us; we shall have National Prohibition instead the day after. The Armistice continues in force between the United States and Germany; therefore business with that country, and her allies, remains under restrictions.

OUR esteemed British contemporary, 'The Mining Magazine', in its enthusiastic appreciation of Mr. Sulman's treatise on flotation, says that "in America, particularly, the [flotation] processes were practically ignored. Many eminent authorities there looked askance at the English inventors, and regarded them as charlatans on the level of gold-brick merchants and bunco-steerers". This is a weird exaggeration. The application of flotation to sundry sulphide ores of copper was developed in the United States after Mr. Sulman and his associates in London had stated that the process could not be applied successfully to them. More has been done in the United States during the last five years to develop and extend flotation than anywhere else, although we are aware that the earlier development of the process is to be credited to the technicians of Broken Hill. No; we do not regard the English "inventors" as "gold-brick merchants and bunco-steerers", nor do we regard them as philanthropists and Sunday-school teachers; indeed, our ideas concerning them have been expressed quite frankly several times in these columns; what St. Peter will do to them when they knock at the pearly gates, we would not venture to forecast. This much, however, we will say, after reading Mr. Sulman's treatise for the purpose of revision before printing it in our paper, namely, that Mr. Sulman writes with the care-

fulness and the consequent clarity that marks the true scientific man, and we would be happy if only more technicians would use an instrument of precision, the English language, with similar care and skill.

HIGH COST is again to the fore in the proposal to increase the annual dues paid by members of the Institute. They have been asked to vote in favor of an increase to \$15 per annum, but as this change cannot become effective for a year, they are requested to pay \$3 extra for the volumes of Transactions issued during 1920. We have not referred to this matter until the voting was done, not caring to interfere, but we do desire to record our opinion that the Institute publishes too much stuff and that it needs more editing, partly to improve the text and partly to abbreviate it. Most of us in the West throw the papers on iron and steel into the waste-paper basket as soon as they reach us; of the mass of material published in the bulletins and the bound volumes, not more than an eighth interests any one member. Here is a lamentable waste, particularly in these days when printing, paper, and postage are increasing continually. Like most engineering societies, the Institute runs to quantity rather than quality, and tends to expand its energies in disregard of the inevitable cost; in short, the Institute publishes too much and may find it necessary before long to raise the dues again. It should meet its increased cost by diminishing the mass and improving the matter of its publications.

SOME of our readers have asked us to state the facts regarding the coinage of silver and the re-melting of coins into bullion. A newly minted dollar weighs 412.5 grains; it contains 371.25 grains of silver and 41.25 grains of copper. Subsidiary coins weigh less than their nominal fraction of a dollar, although the composition of all silver coins is the same. One troy ounce is equivalent to 480 grains, so that a silver dollar actually contains 0.7755 ounces of silver; or, stated otherwise, the market price of silver must be \$1.2926 per ounce if the silver in a dollar coin is to be worth \$1. Obviously then, silver dollars have been worth more as bullion than as coins, for the quotation for silver has averaged \$1.3356 for as much as a week. The Government will purchase silver bullion in any amount, paying for it the price quoted in New York on the day preceding that on which it is deposited at the Mint. If, however, the quotation is a fractional part of a cent, this fraction is dropped in making a set-

tlement; and charges are also made for melting, parting, and assaying the bullion purchased. These charges are not fixed, but depend upon the amount and kind of base metal in the bullion; for instance, the 'finer' the bar, the smaller will be the charges. The only requirement is that at least 200 parts in 1000 are precious metal and that the net value is not less than \$50. While it is a crime to mutilate a coin and then put it into circulation, there is no law prohibiting the melting of coins into bullion. The fact is that millions of silver dollars have lately been converted into bullion and shipped through San Francisco to the Orient, and a great many more are being melted by small 'dealers' who realize a profit by selling directly to the various mints and Government assay-offices in the United States. The Government must hold in the Treasury department in Washington enough dollars to redeem the outstanding silver certificates, but this number is rapidly diminishing as the certificates go out of circulation. The only thing that limits the number of silver dollars melted by those in the business is their ability to obtain them. The mints have not coined dollars for some time and the probable result will be gradually to eliminate the silver dollar from circulation. Not until silver reaches approximately \$1.39 per ounce will it be profitable to melt half-dollar coins, but should this price be exceeded considerably we may look for some depletion in the stock of subsidiary coins.

NOT long ago we gave some facts concerning the Premier mine, in British Columbia, 16 miles from the head of the Portland Canal. We can state authoritatively that a fifth interest was bought by Mr. Minor C. Keith, of the United Fruit Company; and a fifth by the Guggenheim Brothers, who also have an option on another fifth. The prices paid have not been divulged and the figures published are mere guesses. Mr. R. K. Neill opened up the orebody in 1918 under an option from Bush, the locator, for \$100,000, which has been paid out of ore-sales. To illustrate the richness of the ore, we can say that 286 tons brought a return of \$96,000, of which 40% in value was gold and 60% silver, at \$1 per ounce. At one time a face of ore 7 feet high and 6 feet wide averaged \$1000 per ton. The story of the discovery as previously recorded is approximately correct. Mr. Neill found an adit-level 225 feet below the surface and 252 feet long that had been driven by the previous optionees, representing Mr. William B. Thompson, who dropped the venture on the advice of Mr. Henry Krumb, on whom, not Mr. H. R. Plate, devolved the duty of deciding whether to proceed with the venture. This level started in \$6 to \$7 rock and ran in such low-grade material for about 60 feet, gradually sidling leftward into the softer country-rock, a quartz-porphry, until it was entirely away from the lode, which is paralleled for 192 feet. At the end it just touched the lode again, there being a little showing of ore in the right top corner of the face, which assayed only 54 cents per ton. Mr. Neill saw this edge of ore and took a grab-sample, which assayed \$8 per ton. He ran a cross-cut and within

four feet penetrated \$300 ore. The cross-cut was continued for 78 feet farther, and the whole 82 feet averaged \$57 per ton. The silver is in the form of argentite, proustite, and stephanite, or, as a miner would say, silver glance, ruby, and brittle silver. The ore presents no metallurgical difficulty. At present the first-class is being sacked and shipped to the smelter at Tacoma, but later the output of the mine will be subjected to flotation and cyanidation on the spot. A new adit is being driven 250 feet deeper than the prospect-tunnel and is expected to reach the orebody in April.

THERE was a time when the Tanganyika Concessions was regarded as a menace to the copper market. That was ten years ago, when hope had not been disciplined by experience. As we read the account of the recent annual meeting, it seemed as if the last five or six years had never been, for again the invincible optimism of Mr. Robert Williams and his backers shone brightly from the printed pages. Mr. Tyndale White presided and Mr. Charles Rowsell seconded the motion. The same actors; the same play. Nor do we say this in a spirit of satire, for the story of the Tanganyika Concessions is a fine example of Anglo-Celtic initiative and persistence; it exemplifies the adventurous spirit that is the very essence of mining. Mr. Robert Williams we know, and we admire greatly his indomitable energy and his keen sagacity. The shareholders are still backing him to the limit, and have allotted 200,000 shares to him in order to ensure his continued co-operation. In 1919 the Union Minière, the parent Belgian company, made a profit of £700,000. The output of copper last year was 22,000 long tons, but it would have been 40,000 if strikes and other difficulties had not interfered. It is expected to produce 40,000 tons this year. That would be a little less copper than the Utah Copper Company is producing annually. Mr. A. E. Wheeler, formerly of Montana, is consulting engineer to the company. We wish him and Mr. Williams every success in 1920.

REFERRING to deep mining on the Kolar goldfield, in India, and more particularly the impoverishment of the celebrated Mysore mine, we note the statements made at the annual meeting of the Mysore Gold Mining Company, as reported in the 'Financial Times'. It was stated by the chairman, Lord Glenconner, that "a mine that has produced £20,000,000 worth of gold and is still carrying in depth the reef [or vein] which has given such results may be looked upon as offering an unusually good prospect of renewed success". This was greeted with "Hear, hear"; but we venture to suggest that when a mine is 4000 feet deep and is poor in bottom, the prospect is gloomy. The fact that it has yielded millions in gold simply indicates that there are just that many millions fewer to extract. The Right Honorable Chairman added that he and his co-directors were "strengthened to that opinion by the fact that at the Ooregum mine, which is deeper than our own, valuable ore-ground is again being opened up at the deepest points". This is mis-

leading—unintentionally, of course. The ore-shoots of the Kolar goldfield pitch northward at a strong angle, so that any shoot that the Mysore might intercept at, say, 4500 or 5000 feet in vertical depth, would be cut in the Ooregum at between 6000 and 6500 feet, whereas the Ooregum is, we believe, barely 5000 feet deep vertically. Why mention the Ooregum and not the Champion Reef, which comes between the Mysore and the Ooregum? The best evidence concerning the probability of finding new ore-bearing ground in the Mysore should be obtainable from its adjoining neighbor northward, in which any deeper ore-shoots might have been intercepted, because the Champion Reef is the deeper of the two. The fact is that this mine also is sick in the bottom. This vital question of impoverishment in depth is being tackled in an absurdly unscientific way, in disregard of local evidence as well as of world-wide experience. What the Mysore shareholders need is a report by an independent engineer thoroughly versed in the vicissitudes of gold mining. It looks to us as if the patient were extremely ill, and the kindly old family physician were so unwilling to hurt the feelings of the relatives as to object to calling in the aid of a specialist. Moreover, the relatives are so fond of the invalid that they hate the idea of a cold-blooded verdict from an unsympathetic outsider.

SMOULDERING underground fires cause much trouble in metal-mining, entailing difficulties in ventilation, expense for bulkheading, and in many instances the loss of valuable ore. Danger is a minor factor, as methods of fire-fighting have been so perfected that, when the fire has once been controlled, operations in the remainder of the mine usually can continue undisturbed. In exceptional cases, stopping may even be done under forced ventilation within the burning area. Some fires have been smouldering for twenty or thirty years, resisting the best effort to extinguish them. The reason, of course, is found in the rock-fractures that are present in every ore-bearing zone; such crevices admit air sufficient to support combustion, the area usually being so large that concrete bulkheads can only control, not extinguish, the fire. Heavy timbering, such as that in the Butte mines, is always a possible source of danger; but by far the most difficult fires to control are those in sulphide ore. There seems to be good evidence that, when the proportion of sulphur is sufficiently high, fire can start from spontaneous combustion, assisted probably by the heat generated from rock-movement. Such is that in the United Verde mine at Jerome, which has been burning since 1897. Most of this fire is confined to the zone above the 400-foot level, and so far all efforts to stop it have failed. Operations at present under way, however, will extinguish it, quite simply and completely. We refer to the excavation by steam-shovels of the entire burning area, shipping the ore to the smelter, and using the waste to fill some of the near-by ravines. This novel project, which is estimated to take eight years, will involve the removal of some 30,000,000 tons of rock and ore, a truly great undertaking even in these days of mountains of copper and

20,000-ton concentrators. On another page of this issue we publish a short article on the Homestake fire, by Mr. R. G. Wayland, the assistant superintendent.

Public Service and Public Practice—II

In our last issue we discussed some phases of this interesting question, illustrating them by reference, more particularly, to the activities of the College of Agriculture in the University of California, and suggesting the effect of their example on the Engineering departments. On inquiry, we find that, at our State University, there is no regulation limiting the outside professional activities of any member of the Engineering departments, or of the Chemistry and Geology departments, so that it is left to the individual professor to decide how much work he will perform. Occasionally an individual has been subjected to criticism for neglecting his University duties for outside professional business, and he has been warned by his departmental chief or by the president to pay stricter regard to his proper functions. This, however, is a matter of internal policy, which is not regulated by any fixed rule. Some professors refuse to engage in outside work because it interferes with their scientific research; some undertake it only during the vacation; others undertake it only when it is offered; a few actually solicit it. Custom in this regard is much the same in other universities. In many of them the professors of engineering have accepted their appointments on the understanding that they will be permitted to practise; indeed, it is believed officially that such practice adds to their efficiency as teachers. That is a popular delusion. We believe that a professor can enrich his lectures just as much, if not more, by visiting a number of mines in a given district as by making a detailed examination of one of them. This applies likewise to mills and smelters. The details collected for a report on a specific enterprise are not usually such as can be employed advantageously in teaching, which is directed mainly to the elucidation of principles; moreover, the detailed information obtained in confidence by a consultant may not be released for public use. The young men in college are not being made into superintendents or managers, they are being prepared for the several years of apprenticeship that precedes appointment to such positions of responsibility. After all, a professor is much in the same position as an editor; both are teaching, elucidating, and interpreting; but the editor faces an adult class. If he is in search of material to aid him in his efforts to provide articles that are useful and interesting, he visits a number of mines, mills, or smelters, not one only, and he collects data that can be used for comparison, in order to interpret the trend and development of technical practice, rather than the data necessary to appraise an individual undertaking in terms of money. Editors should not engage in engineering practice, for the reasons that apply to professors. Such practice does not increase the efficiency of either; this can be maintained just as well by journeys of obser-

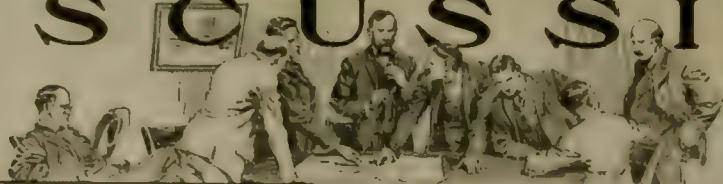
vation, provided, of course, that they have had experience in the field before they became either editors or professors. Next, by engaging in outside work, they become entangled with commercial enterprises of varying respectability; they may become involved, without fault of their own, in a public fiasco or a disgraceful failure, the effect of which reacts upon the journal or the college with which they are identified. It is true, the professor may compete with his own graduated students, but this argument we set aside; the objections to outside practice on the part of professors are not, we believe, based on any such motive as petty jealousy; more nearly the motive is the solicitude of graduates for the good name of their alma mater. Moreover, they have regard for the repute of their profession, and on account of that they, as we do, deprecate outside practice by professors. It is our belief that members of University faculties are called for advice largely because of the prestige of their position, rather than their exceptional fitness or skill; indeed we believe that sincere application to scientific research and to class teaching gradually unfits a man for commercial work, and that therefore the successful teacher is rarely a good technical consultant on mining or metallurgical operations. A specially regrettable phase of the question is the engagement of professors as witnesses, or 'experts', in lawsuits. They become hired advocates for one or other side; ceasing to be scientific, they become crassly commercial. In suits brought against public utility corporations, it is not uncommon to find professors serving as hired advocates to buttress an invasion of private rights; in such cases the honesty of the testimony not infrequently is ridiculed by the opposing side, and even by third parties, to the injury of the University with which the witness is identified. The most glaring examples of such scandals are afforded by apex-suits over mining properties, in which a number of honorable professors on one side swear a thing is black, while an equal number of equally honorable professors on the opposite side swear that it is white. Such exhibitions tend to disparage scientific authority, they throw discredit upon institutions of learning, they degrade the profession of mining geologist. It is high time that they were ended by agreement between the litigants to provide for testimony that is not hired by either side, but selected by the Court itself. However, that is another story. The subject is only worthy of discussion if a remedy can be devised or a principle evolved. We think it is possible to discern a basic principle for guidance amid this clash of moral and commercial interests. It is a simple one. Confine outside work to such as is of public value, that is, to such as is valuable to the community, local or national. Thus professors might serve on State and National commissions of inquiry and advice; they might be arbitrators in matters of public controversy; they might make investigations and reports for the public good, such as are initiated by municipalities or States; they might be retained to study specific mining or metallurgical operations if they have unique knowledge or experience especially fitting them, above all others, for

the task. In every case the public interest should be served by prompt publication of the results of such work; in no case should it be done confidentially for a private client or in behalf of an individual commercial interest. The idea that Professor Jones performs any public service by advising Mr. Brown to buy a given mine, or that Professor Smith does anything useful for his science or for his University when he uses his ability to support a line of argument prepared by somebody in a lawsuit, is absurd. If, on the other hand, either Professor Jones or Professor Smith, as a specialist, assists a court of justice, a municipality, or a State in ascertaining the truth, which is the primary function of the scientist, he will be doing a public service, for which he is entitled to be paid in proportion to the value of his work. We believe that if the idea of public service be adopted as the keystone of policy in regard to the outside practice of professors, and other holders of public office, it will be possible to develop a custom more honorable to all concerned and of more general usefulness than any at present in vogue. In such matters the force of public opinion will dominate; for that reason, we invite letters on the subject for publication.

Money for Europe

Amid the frothings of the Hearst hysteria it is satisfactory to read Mr. Hoover's sane pronouncement on the question of loans to Europe. He makes clear the distinction between a Government loan and commercial credits; the first leads to a persistent pauperization of the war-devastated countries, checking the rehabilitation of normal industry, whereas commercial credits, for which most of them still have the requisite assets, encourage a mobilization of domestic resources and a stimulation of productive labor. Austria, and more particularly its capital, Vienna, will need direct help—perhaps Poland also—but in the main our effort should be directed toward reorganization and resumption of industry rather than a glorified soup-kitchen kind of dole to the unfortunate peoples on the other side of the Atlantic. Any immediate charitable aid need not run into such sums as will necessitate a big Government loan, which means increased taxation for our people; such help can come from the reserves of the Grain Corporation. Now that the Treaty has become a fact, the first thing to do is to have some co-operation in financial measures, so that international exchange may be stabilized on some basis more favorable to business. On all these matters Mr. Hoover is exceptionally qualified to speak; no American, probably no European, is better informed concerning conditions in Europe, and it is much to be desired that his views be given proper attention at Washington. By the way, a few days ago a straw-vote for Presidential possibilities was taken during luncheon time at the Engineers Club in San Francisco: out of 72 votes, Mr. Hoover received 54, Senator Johnson got one, several others got one each, and one vote was marked "Any Republican".

DISCUSSION



Prohibition

The Editor:

Sir—As an old subscriber to your excellent paper, may I claim a little space to criticize your attitude on the prohibition issue. In your issue of December 13, you criticize a writer for saying that prohibition would be a loss to the country. Without going into arguments about the morality of the drink question (and let it never be forgotten that the wine and beer users of France and Great Britain were quitting themselves like men when thousands of prohibitionists were spreading discord and unrest in the United States and Canada) let us review the question of loss of revenue through prohibition.

The Allies today are faced with enormous war-debts. Business and professional men will be taxed almost beyond endurance before this debt is paid, whereas the average working-man, earning in many cases large wages, gets off scot free. What tax can you suggest that will bring in more revenue and be fairer than a heavy tax on beer and wine?

Theories pay no bills, and money must be raised. Why not make liquor a Government monopoly and charge a stiff price for it? Central stores could be established in each centre of, say 10,000 population. Put the stores in charge of a first-class Government official. Hold him responsible for the sobriety of his district. Register each customer by number and record his purchases day by day. If a complaint is made against a man for drunkenness, cancel his license, and make it punishable by a stiff fine for any man to give him liquor.

I have lived in Canada for several years under prohibition; I have read in the papers of the great benefits that prohibition will bring upon a country that adopts it; we are told that jails will be empty and crime decrease, etc. Such is not the case in Canada; crime is on the increase. We have 'blind pigs' and stills galore, and the cost of policing the Province is enormous; it far exceeds the cost of police protection before prohibition was enacted.

The trouble with the average prohibitionist is that he will not face facts. He is governed by sentiment or the fear that his family may suffer through strong drink, and therefore he argues that strong drink must be abolished, forgetting, in his ignorance, that there are evils in the world that cannot be abolished, only controlled. The social evil, as Kipling says, is the oldest on earth. Does any sensible man think it can be abolished? Marriage is in many cases a failure. Shall we abolish marriage? It is a notable fact that no great statesman or leader of

men from Jesus Christ down to the present age has ever been a prohibitionist. This party has to depend on such men as W. J. Bryan and Billy Sunday. I am sorry, Sir, to see you in such company.

We are told solemnly by the worthy prohibitionist that drink causes physical deterioration. Was this the case with the sailors that manned the British navy or the men in the trenches? Germany has not been a prohibition nation, and whatever we can say about the effects of drink on them mentally, the Germans certainly kept the world busy to lick them. The Turks are practically prohibitionists. Are they by any means a model or an efficient nation compared with other nations? It is well to bear in mind that most nations that use no liquor are controlled by people that use well and moderately the good gifts of God.

It is also well to bear in mind that most of the good reforms come by evolution. We have enacted drastic laws in England and the United States years ago, and, like the present prohibition movement, they will fail, as the churches are failing today, because instead of following a doctrine of love, they are using a big stick.

The curse of the world is the extremist. The Kaiser was a military extremist, and plunged the world in misery. Who will say that Lloyd George and Herbert Asquith were not extremists when they took the stand against a larger army and navy, which might have averted the war, as the Social Democrats of Germany were rapidly increasing and were getting tired of the Kaiser's policy?

In conclusion, Mr. Editor, I hope you will take my criticism in the spirit it is meant, without malice. There are thousands of men in Canada today who are not interested in the liquor trade, and many of whom do not use liquor themselves, who realize that the policy of prohibition for Canada is suicidal. Our hewers of wood and drawers of water came mostly from beer and wine-using countries. These immigrants are passing us up, and many of our best workmen are returning to Europe. And all this is being brought about by a well-organized body of well-meaning people who do not realize the task they have undertaken and are indifferent to anything but riding their own hobby.

I have faith enough in the old law-makers to believe that if drink is such a curse as the prohibitionists would try to make us believe, that an eleventh commandment would have been added forbidding the use of liquor. Mr. Editor, do not kid yourself with prohibition buncombe such as has been published in Canada and elsewhere.

Any sane business man in Canada knows only too well that we have suffered a financial loss through prohibition. The War caused a season of high wages, and we now have the bill to pay. It is not the time to try experiments. The British government is not asleep on financial matters and realizes that it cannot afford to lose the liquor income because a small percentage of her citizens abuse liquor. By adopting a policy of strict control, the liquor business can be handled successfully. Prohibition can never succeed, because as a famous statesman has said, "no law can be successful when opposed by a large minority".

F. J. BOURNE.

Cobalt, Ontario, December 20.

[Our correspondent should not class us with prohibitionists, but only with those willing to accept the decision of the majority in this democracy. We dislike any interference with our personal habits, and in this respect we resemble other good citizens, but we recognize our obligation not to 'kick against the pricks', but, rather, goodnaturedly to comply with the law as enacted by Congress. Extremists are unpleasant people, we acknowledge, but we are not of them. We cannot accept the notion that loss of revenue is an argument against prohibition, because those living in States that 'went dry' before the Federal enactment unite in testifying to the increase of business and the improvement in public morals consequent upon compulsory abstinence.—EDITOR.]

The Industrial Conference

The Editor:

Sir—In your editorial on this subject, appearing in the issue of January 10, you call attention to the fact that the purpose of the Conference at this time is to devise machinery for the adjustment of disputes, not to discuss the causes of them. However, I take it that you will agree that the "causes" must sooner or later be found and eradicated if we are to reach a satisfactory basis for carrying on industry. My idea is that this cannot be brought about until some arrangement is reached whereby manual workers are able to see advantage for themselves as individuals, and as a class, for putting forth their best effort.

A fundamental tenet of radical labor-unionism is the principle that an irreconcilable conflict exists between the interests of 'capital' on the one hand and of 'labor' on the other; that anything that can possibly be of advantage to the employer must necessarily work to the disadvantage of the employed. To this patently unsound doctrine is added the theory that 'direct action' is labor's only effectual weapon in the struggle for supremacy, and that the end always justifies the means. It is then natural that a large proportion of even the more conservative workers honestly believe that their own interests are best served by doing the minimum amount of work for the largest wages that the employers can be forced to pay. On the other hand, it seems to me that the employer does not come into court with entirely clean

hands. Too generally in the past his policy has been dictated by opportunism. When the supply of men, who must work to live, has been plentiful and work scarce, wages have been cut and employees have been driven to greater effort. Labor efficiency has been regulated largely by the length of the daily line of applicants seeking work; a man will work harder to hold his job if there are fifty equally good men waiting for the first opportunity to take his place, for by the same token he will have just that much more difficulty getting another job if he is discharged. Just now the worker is having his turn, for there are more places than there are men, and the result is the much-decried inefficiency in mining as well as in other industries throughout the country. 'A fair day's work for a fair day's pay', while a step in the right direction, does not go far enough. There must be provision for the man who by superior skill or intelligence, or by more industrious effort, can and does do more than "a fair day's work". He must be paid exactly in proportion to the value of his service to the enterprise, while the less capable man, earning the minimum wage, must receive enough to provide the reasonable requirements of a decent existence. One step toward a solution of the present problem of industrial inefficiency is the honest application of the principle of the 'square deal'—for the employer and the employee alike. The employer is rapidly coming to the realization of this fact, but the process of convincing the worker and gaining his co-operation will doubtless be slow and difficult. Past experience unfortunately is not calculated to instill confidence in the average worker as to the likelihood of getting square treatment from the man for whom he works. The development of mutual trust seems to be the first essential.

I should like to hear the views of some of your other readers regarding this subject, particularly those who have been working to promote understanding between the working man and his employer. I think discussion in which a 'spade' is called a 'spade' will do good rather than harm.

OBSERVER.

San Francisco, January 10.

Smelting Iron Ores

The Editor:

Sir—In reply to Dwight E. Woodbridge's criticism of my letter on the smelting of iron ores on the Pacific Coast, I take it, though his wording does not leave the matter exactly clear, that he denies that magnetite un-mixed with other iron ores cannot be smelted by ordinary blast-furnace methods. If Mr. Woodbridge can give instances of where straight magnetite is being smelted economically by ordinary blast-furnace practice he will be conferring a favor on a considerable number of people, who are under the same 'delusion' as myself. It would be interesting, too, if he could give the ratio of coke to ore in the operation and the temperature at which the magnetite is reduced.

F. H. MASON.

Victoria, B. C., December 31.

Chloridizing Processes

By HARAI R. LAYNG

*The revival of interest in chloridizing volatilization processes will result in a successful application of one or other of them. The failures resulting from attempts to conduct various methods on a commercial scale† were in my opinion due to lack of sufficient knowledge of the then unknown chemical reactions and of certain peculiar effects of heat.

During the early years of the European war I had the opportunity of observing the attempts made with three different shaft-furnace plants to treat antimony ores by volatilization, all of which failed. My observations of these attempts caused me to believe that the process could be best carried on in a furnace of the revolving-kiln type. I tried treating the ore in a small furnace and got such good results that a furnace 24 ft. long by 38 in. diameter on the feed and flue end and 50 in. diameter on the fire and discharge end was installed. The early work with this furnace did not result in better than 60% extractions. I found that the low heat at, or toward, the flue end caused the antimony tri-oxide fume to be oxidized to the non-volatile tetra-oxide, which precipitated in the furnace and mixed with the molten stibnite to form an almost non-volatile oxy-sulphide. This stuck to the wall of the furnace and balled the charge so much that it was necessary to shut the furnace down for cleaning purposes at intervals of a few days. I then made changes that caused the flue end to be hotter, thereby causing the ore to be heated more quickly, a procedure that resulted in doubling the capacity of the furnace and yielding higher extractions, which were eventually brought to over 90%, and, furthermore almost completely eliminated the cause of the costly shut-downs for cleaning purposes.

The operations of the antimony plant had shown me that the more rapidly the ore could be heated to a point sufficiently high to prevent harmful reactions from occurring and cause good rates of volatilization, the better the resulting extraction.

During the past two years I have conducted many tests on a number of ores with chloridizing methods and I find that in chloridizing volatilization also it is necessary to heat the ore quickly in order to prevent harmful reactions. These would probably involve the formation of non-volatile or nearly non-volatile compounds like oxy-chloride of lead, oxides of copper, or alkaline zincates, or alkaline lead silicates; also the formation of fused compounds, like, for example, sodium sulphate, which coat

the minerals in the ore and hinder the proper reactions, or prevent volatilization of the metal compound so encased. Slow heating not only causes low extractions, due to these harmful reactions, but also decreases the capacity of the furnace, and therefore entails an excessive consumption of fuel. It may also prevent the development of beneficial reactions.

It is probably due, mainly, to the serious effect of slow heating, especially when sodium chloride is used, that most of the large-scale attempts heretofore made with chloridizing volatilization processes have been unsuccessful. These attempts were conducted usually in rotary-kiln furnaces that were fired at the discharge end, the aim evidently being directed to economy of heat by minimizing the difference in temperature between the gases leaving the furnace and the charge entering it at the same place. Such procedure in the long furnaces required for commercial work would naturally result in the ore being slowly heated, which would cause low extractions or low furnace-capacity, and consequent failure.

The importance of rapid heating is apparently not recognized by Mr. Croasdale, who after having failed with 25-ft. furnaces now proposes furnaces of the regular cement-kiln type from 75 to 100 ft. long. Mr. Stevens also seems to favor the long kiln-furnace. G. H. Wigton in Patent No. 1,264,586 states that the ore should be slowly heated.

The fact that slow heating, especially in cases wherein sodium chloride is the chloride used, is the cause of poor results is clearly proved by tests that I conducted on a number of different types of ore. One ore gave the following analysis:

Before treatment (analysis)		After treatment (estimate per ton of untreated ore)	
Au	0.03 oz.	Au	None
Ag	10.86 oz.	Ag	None
PbCO ₃	15.78 = 10.8 % Pb*	Pb	None
PbSO ₄	2.41 = 0.38 % S	SO ₃	0.95
ZnCO ₃	19.13 = 9.7 % Zn	ZnO	12.12
CaO.SiO	27.02 = 14.0 % SiO ₂	CaO.SiO	27.02
CaCO ₃	12.34 = 19.93 % CaO†	CaO	6.91
FeCO ₃	21.74 = 15.00 % Fe ₂ O ₃	Fe ₂ O ₃	15.00
CuCO ₃ .Cu(OH) ₂	1.91 = 1.1 % Cu	CuO	0.28
Deduct error	0.33		

Total 100.00%

*Includes Pb in PbSO₄. †Includes CaO in CaO.SiO.

62.28

Lead soluble in saturated brine = 14% extraction.

The loss of weight by treatment, according to the analyses, would be 37.72%. A small test made with 150 grammes of 10-mesh ore and 17 gm. of CaCl₂.2H₂O mixed with water to form a cake resulted in an almost complete extraction of lead, silver, and gold, the copper extraction being over 75%, whereas only traces of zinc were extracted. The loss of weight was 36.8%. Allowing 6.95 gm. of additional weight to the heading for the CaO resulting from the decomposition of the calcium chlo-

*The disclosures made hereinafter are subject to patent applications by the author; some of the patent applications are prepared, others are being prepared.

†'The Chloride-Volatilization Process', by Blamey Stevens. 'M. & S. P.', July 12, 1919. Also discussion of preceding by Stuart Croasdale in the issue of August 9, 1919.

ride (there was no dust loss because the charge was not rabbled, and consequently retained its original form throughout the test). The difference between the loss shown by analysis and that shown by the small test is insignificant and could be accounted for by slight variation in sampling and weighing and to moisture absorbed by the ore used in the test.

The tests shown on the charts were run on the same character of ore as shown by the preceding analysis. The charges were sampled every five or ten minutes as indicated by the station dots on the chart. Tests marked 1, 2, and 3, were made with 11% NaCl added to the ore. Those marked No. 4 and 5 were made with $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, 11% and 9% respectively. The low extraction in No. 5 was due to small amount of clinker formed and to poor mixture of lumpy chloride and ore.

These tests prove the necessity and effect of rapid heating, especially when sodium chloride is used. Test No. 5 shows an extraction line almost paralleling the temperature line, proving that the extraction can be obtained almost as quickly as the ore can be heated.

There are many ways of heating the ore rapidly; for example, a revolving furnace could be heated at the feed end; or, if a very long furnace, it could be heated at both ends. Another example would be a furnace of the shaft type, like the Stedfeldt or Scott, in which the heat is applied at any desired point. With the shaft-furnaces the extraction could probably be obtained in a few minutes, especially when chlorides of the alkaline earths are used.

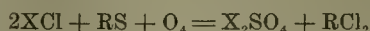
The consumption of fuel in the chloridizing-volatilization process will not be a serious item. In the case of an ore somewhat similar to the analysis quoted above, to which would be added 10% of its weight of salt, the chemical consumption of heat, allowing for all thermochemical reactions, including heating of the ore, salt, and gases therefrom, to 1000°C ., would amount to 701 B.T.U. per pound of ore. Allowing 100% excess air for burning fuel-oil of 20,000 B.T.U. grade and allowing the air to be pre-heated to 600°F . by means of the heat of the flue-gases, which are allowed a temperature of 700°C . as they leave the furnace, there would be 13,512 B.T.U. per pound of oil available for heating the ore and for furnace radiation. Assuming that the furnace radiation is 15% of the total heat-units in the oil, there would remain 10,512 B.T.U. per pound of oil, or sufficient to heat 15 lb. of ore. The fuel consumption would therefore be 6 $\frac{2}{3}$ %.

In the case of a small multiple-hearth furnace having a capacity, with this method of heating, of one ton per day and equipped with air-cooled rabbles, about half of the air from the rabbles being returned to the furnace through the burners, but not equipped for utilizing the heat of the flue-gases other than to slightly pre-heat the ore, the fuel consumption was at the rate of 60 gal. per ton of ore. It will certainly prove advisable in practice to utilize the heat of the flue-gases for either pre-heating the air entering the furnace or for partly drying the ore, or for both purposes.

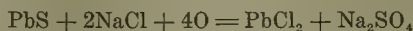
The analysis shows that the ore does not contain sufficient sulphur to complete the reactions illustrated in Mr.

Croasdale's U. S. Patent No. 741,712, and, furthermore, it clearly shows that there is no free silica, which, according to Mr. Wigton's U. S. Patent No. 1,264,586, is essential. Tests made on this ore as well as tests on other ores in which sodium chloride and sulphur or silica were used in amounts according to the reactions of Mr. Croasdale's or Mr. Wigton's patent specifications resulted in lower extractions than those of parallel tests run at the same time under the same conditions excepting for the omission of added sulphur or silica in the parallel tests.

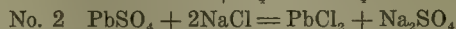
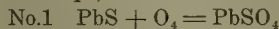
Mr. Croasdale illustrates the principle of his patent by the equation:



In the case of a lead sulphide ore in which sodium chloride is used, the translation of the above equation would be



Such chemical change would not occur in one step; it would require two steps, as follows:

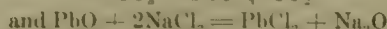
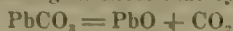


However, when lead sulphide is roasted in air, as in practice, the resulting product consists of a mixture of PbO and PbSO₄ and occasionally some undecomposed PbS. The remainder of the sulphur is oxidized and liberated in the form of SO₂. The proportional amount of PbSO₄ formed is not sufficient to cause a 'complete' extraction of the lead as lead chloride according to step No. 2; furthermore, step No. 2 is not a good reaction for volatilization because the sodium sulphate formed coats some of the lead compound and either hinders the formation of lead chloride or prevents its economical volatilization. The PbO does not combine directly with NaCl to form lead chloride, and if the PbO formed during the roasting of the PbS were coated with either molten sodium chloride or sodium sulphate (the latter from the second step) it would not be acted upon. Now, if water-vapor is present this would react with the SO₂ gas and the sodium chloride to form HCl, which would combine with any PbO, uncoated by sodium, and thereby form the volatile lead chloride. Copper ores would act similarly as in the case just mentioned with the exception that the chlorides of copper are unstable in the presence of air at the temperature required for the volatilization process and are easily converted to CuO; but when water vapors are present they would result in the formation of hydrochloric acid, which would unite with CuO to form a chloride. Chlorine does not combine with CuO at a temperature of about 400°C . when air is present, but HCl does. Chlorine does not combine with CuSO₄, either in cold solutions or heated salts, to form chlorides of copper, but HCl does.

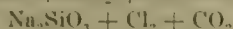
Zinc is only volatilized in chloridizing-volatilization processes when it is in the presence of sulphur; zinc is not volatilized quantitatively from ores wherein it exists in the form of an oxide or carbonate unless sulphur in some available form is present or is added to the ore; whereas lead can be volatilized in either case. The reactions in the case of zinc sulphides could be illustrated as in Mr.

Croasdale's patent. In any case, where zinc sulphide is treated in the presence of sodium chloride, trouble from a coating of sodium sulphate is inevitable.

The process of Selden Irwin Clawson (Patent No. 1,192,037) would, in general, in so far as the reactions hereinbefore are concerned, be similar to Mr. Croasdale's. George Wigton, in his patent No. 1,264,586, among other things limits his patent to a reaction wherein a silicate like sodium silicate is formed. He then attempts to qualify this by stating in effect that by heat



But in his illustration, he publishes the reactions



This last reaction appears very doubtful. I have found in tests with ore and in tests with pure reagents that

2. Abundant lead chloride fume was given off when litharge was treated with $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, or $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ or the fused product resulting from fusing $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ at high heat. All the lead remaining was found to be lead chloride.

3. Pure galena with sodium chloride acted the same as in PbO , with the exception that the solution of the fused product contained only faint traces of lead.

4. Pure galena with $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ gave off an abundance of lead chloride fume. No fused coatings like sodium sulphate were formed. On boiling for a few minutes a saturated solution of sodium chloride containing galena, only a faint trace of lead was found in solution, whereas with both calcium and magnesium chloride solutions appreciable quantities of lead were found in solution. The magnesium chloride solution contained the most lead. The same treatment in parallel tests with the analyzed

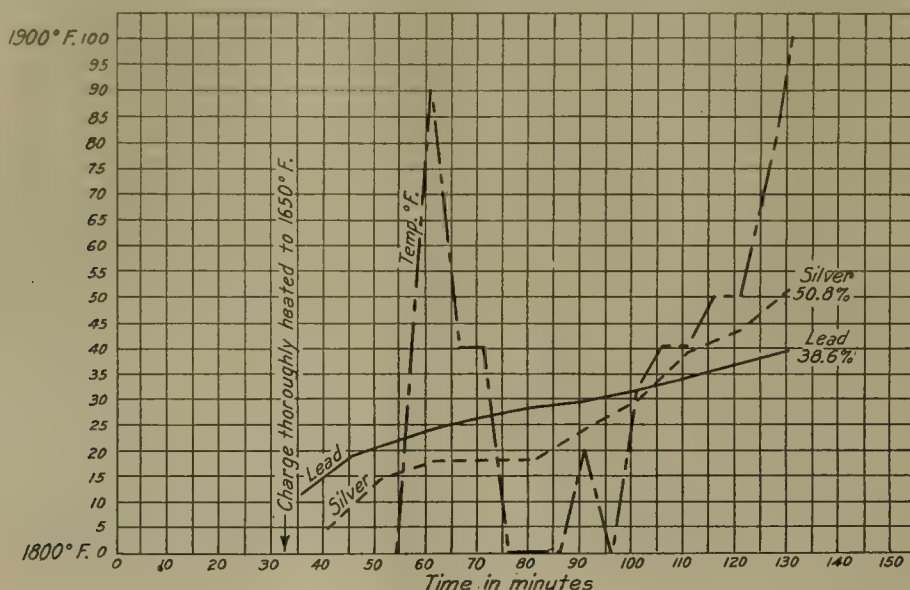


CHART NO. 1

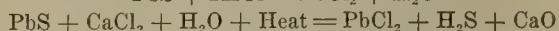
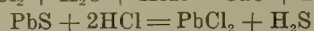
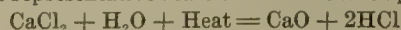
$\text{PbO} + \text{NaCl} + \text{Heat}$ does not quantitatively result in the volatilization of lead chloride, and that whenever sodium silicate is formed the extraction is reduced as the sodium silicate increases.

I have found, both by tests on ores and by direct experiment on minerals and reagents, that the action of sodium chloride in chloridizing metallurgy differs greatly from the action of chlorides of the alkaline earths and that sodium chloride is much inferior to chlorides of the alkaline earths. By direct tests on minerals and reagents conducted in an open crucible over a bunsen burner, the results are as follows:

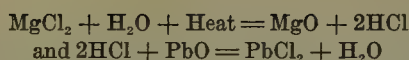
1. No lead chloride fume was detected when salt and litharge were heated to fusion and above the boiling-point of lead chloride. The fused product, when treated with water and the mixture boiled to saturation of the solution, showed only very small quantities of lead chloride in the solution.

ore shown in the fore part of this article resulted in 14% extraction of lead by means of sodium chloride solution, about 60% extraction with calcium chloride solution, and over 99% with magnesium chloride solution. Magnesium chloride, and in some cases calcium chloride solutions, could be used to extract the metals from some ores to better advantage than the acidified brine solutions that are usually recommended.

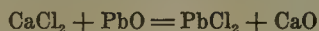
I have not decided as to just what reaction takes place between sulphides like lead sulphide and chlorides like alkaline-earth chlorides, but it appears that the following may be a representative reaction when heat is applied:



The H_2S would probably be further oxidized by the furnace gases. In the case of oxides like PbO the reactions would probably be



or, in the case of fused calcium chloride, it may possibly be



If the amount of water-vapor present were reduced, chlorine would be liberated instead of HCl according as the amount of water-vapor varied; in such cases the reactions would be different than those illustrated above.

The desired action of sodium chloride with ores containing little or no sulphur or silica, appears to be due to the action of some element or compound such as a form of oxygen or water-vapor contained in the furnace gases either by the aid of a catalyzer or by dissociation of

the necessity of high heat, the necessity of exposing the mineral to the gases, which is unnecessary when other chloridizing agents are used, the absence of direct reaction between lead oxide and sodium chloride, and the effects of coatings like silicates or sulphates, it is reasonable to believe that the sodium chloride is altered by the actions of the gases to a sodium compound like Na_2O and chlorine or hydrochloric acid, and the active chlorine or compound thereof attacks the lead compound to form lead chloride before the sodium compound can react with silica, lead, or both, to form fusible non-volatile compounds; also, that should the lead chloride thus formed become mixed with the other fusible compound, a great part of the lead chloride would distil out of such a mix-

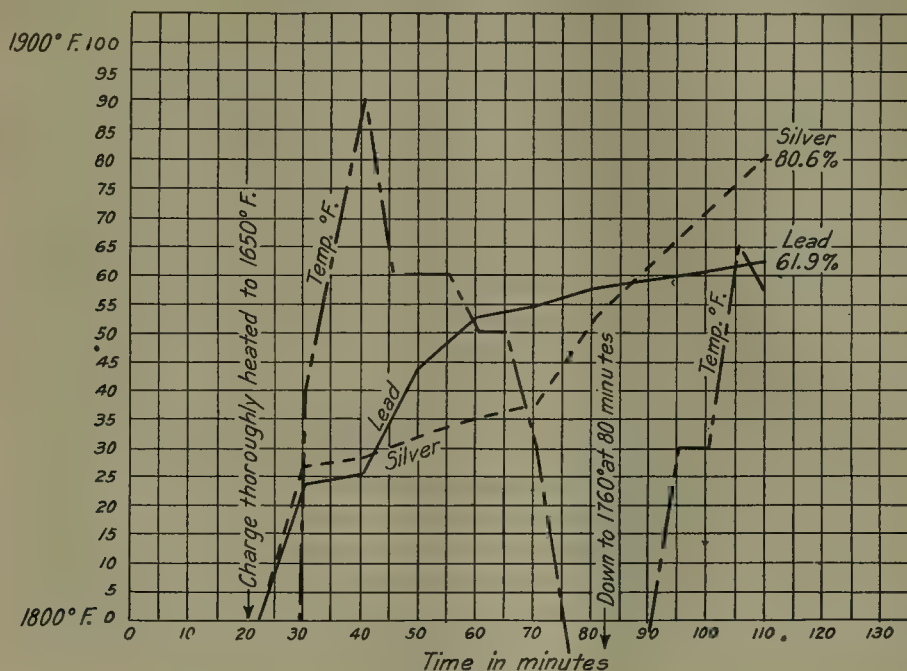


CHART NO. 2

sodium chloride vapor at high heat in the presence of elements or compounds contained in the furnace gases.

In many, if not all, cases wherein sodium chloride is the chloridizing agent, it is necessary to expose the ore particles to gases, like those from the furnace, containing air or water-vapor, or both, in order to obtain good extractions. It appears, in lead oxide or carbonate, that the desired chloridizing of the lead, when sodium chloride is used in the presence of gases, takes place only at high temperatures, apparently above the boiling-point of sodium chloride, which temperatures are very much greater than the temperatures required by chlorides of the alkaline earths.

The effect of slow heating is more detrimental to chloridizing volatilization when sodium chloride is used, especially in the case of lead oxide, than in the case of alkaline-earth chlorides.

Taking into consideration the effect of slow heating,

ture because of its (lead chloride) high vapor-pressure at the temperature under consideration. Sodium chloride does give good results in some such cases but the results are not as good nor are they as easily obtained as those obtained by the use of the alkaline earth chlorides in otherwise parallel tests.

With all the ores I have thus far tried to treat by means of wetting them with solutions of either calcium or magnesium chlorides and forming cakes thereby, and heating them without rabbling or disturbing the cakes during the treatment, I have gotten just as high extractions (extractions varying from 90 to 99+) as were obtained with parallel tests run at same time but rabbled throughout and without wetting. This in the case of chlorides like alkaline earth chlorides proves that rabbling is not necessary and that it is not necessary to have each particle of ore exposed to the gases of the furnace; however when sodium chloride is the main chloridizing

agent used I found that rabbling was necessary to produce good results.

The fact that good extractions can be obtained from ore molded into cakes that only expose one face to the furnace gases and that are not broken during treatment, certainly proves how little air is necessary.

The best furnace conditions would depend mainly upon the ore or mineral and the chloridizing agent. To volatilize some metals as chlorides, reducing conditions would be necessary; whereas with other metals, neutral or oxidizing conditions would be best. In some cases of copper, or like ores, highly oxidizing conditions should be avoided. In the case of an ore like the one shown by the analysis quoted above, reducing conditions would,

than do cotton bags. This fact is learned from the bleaching and cleaning industries.

In the Pohle-Croasdale plant at Mayer, Arizona*, woolen bags were used. The results there may have prompted the doubt regarding the efficiency of bag-houses.

When using bag-houses it would be a good plan to feed an alkali or an alkaline earth to the flue-gases before they enter the bags, because this procedure will not only neutralize free acid and thereby save the bags, but it will also save chlorine. It will probably be found necessary or advisable, in order to cut down the equipment and operating costs, to make an addition of an alkali or alkaline earth (as carbonate or oxide) to the

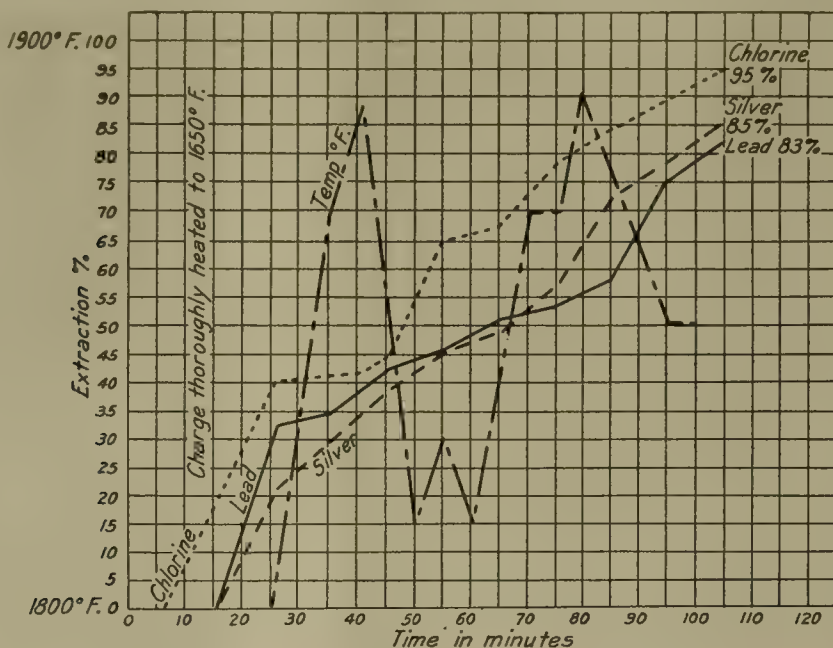


CHART No. 3

among other obvious happenings, cause the ore to slag.

Reference is made by some people to the supposed difficulty attending the collection of the fume. It is said by a few, and referred to by others, that the Cottrell system is the cure for all evils and it is also stated that that system is the only one which will successfully or advantageously collect the fume from chloridizing volatilization. These fumes are more easily collected than antimony oxide fumes, which are almost completely caught by means of properly designed chambers and bag-houses, or absorption devices, like spray or coke-towers. I have not experienced any difficulty whatsoever in preventing the escape, even to traces of chloride fume that were sent to a bag-plant. The bags will collect as much, if not more, of the chloride fume sent to them than will a Cottrell plant. I have found that cotton bags stand the chloride gases better than they stand sulphurous gases. Woolen bags will not stand the chloride fumes, although they withstand sulphurous fumes much better

furnace-gases before they enter a Cottrell plant, since free hydrochloric acid or moist chlorine gas would injure the metal parts.

A scrubbing or absorption system should prove advantageous. Such systems are cheaply erected; they require little attention; they are almost fool-proof, and are more cheaply operated than any other system. With such a system it is possible to make numerous separations. Take, for example, a lead-zinc-copper-gold-silver ore that is being treated by chloridization-volatilization. The fume, containing all the metals as chlorides, could be sent to the lower part of a tower filled with pieces of, say, limestone, over the surface of which trickles a solution, say, of calcium chloride, which is fed at the top of the tower and which after passing through the porous filling of limestone is drawn from the tower at a point near the base. The ascending gases, containing the chlorides, on passing through the porous fill, come in direct contact

*M. & S. P., September 1, 1906.

with the descending solution. Such chlorides as lead chloride are thereby dissolved in the descending solution, whereas such chlorides as zinc chloride are insoluble. Any free chlorine or hydrochloric acid in the gases reacts with the limestone to form calcium chloride or any oxy-chloride, and is thereby recovered. Calcium oxy-chloride, or chloride of lime, is an effective chloridizing agent in volatilizing processes. The valuable chlorides in the fume are recovered either as dissolved metals in the solution or insoluble salts of the metals suspended in the solution and they are removed at the base of the tower, together with any ore-dust or calcium sulphate. The solutions and the suspended particles can be treated by any one of several methods; for instance, they may be

after treatment can be returned to the tower for re-use or they can be otherwise disposed of, for example, by mixing with the ore. With insoluble anodes the precipitation is not complete, but, as the solution need not be thrown to waste, it matters but little if the precipitation is not complete so long as an appreciable precipitation takes place. Chlorine will be liberated when insoluble anodes are used, and this chlorine can either be returned to the tower or fed to the furnace to chloridize the minerals. The cathode efficiency is high when complete precipitation is not attempted. The use of insoluble anodes in this way would be cheaper than the use of soluble anodes.

When the ore contains so much sulphur as to cause un-

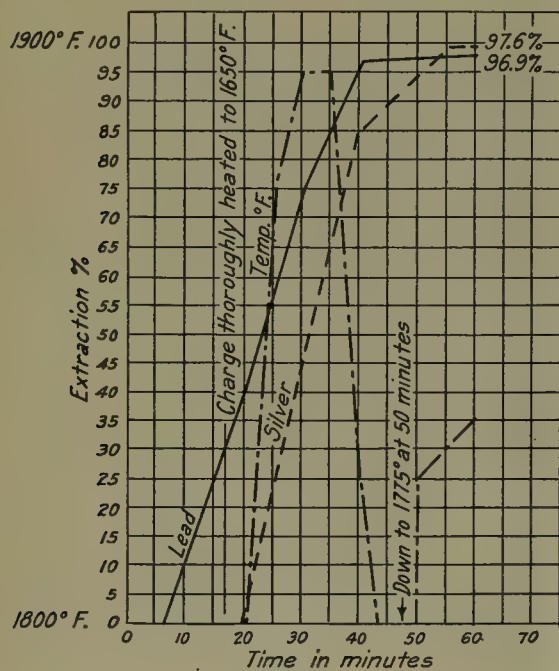


CHART No. 4

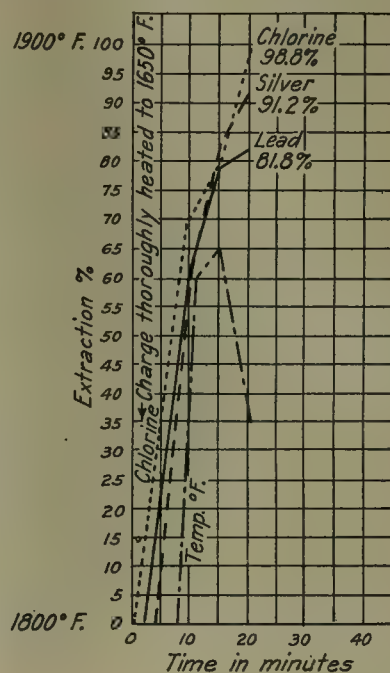


CHART No. 5

treated by settlers, or a series of settlers, to remove the suspended particles such as zinc chloride, which can be treated as desired to recover the zinc and the chlorine. Then the solutions may be treated with lime to precipitate the metals, and the precipitate may be treated to recover the chlorine and the metals; or they may be treated with a precipitant like lead to precipitate any silver, gold, and copper; or they may first be treated with copper to precipitate the gold and silver and then with lead to precipitate the copper. The solution containing lead chloride may then be precipitated by lime and the product smelted with an alkali or alkaline-earth carbonate and carbon to produce lead bullion and recover the chloride; or the precipitate may be shipped to the market; or the solution containing lead chloride may be treated by electrolysis to precipitate the lead. If soluble anodes are used, no chlorine is liberated and the lead can be almost completely precipitated. The solutions

profitable consumption of limestone, an insoluble filling and water could be used in place of the limestone and calcium chloride solutions. Then the zinc chloride would be the soluble chloride, as well as the copper and some silver, whereas the lead chloride would be mostly insoluble. The metals could be separated and recovered by well-known methods.

Perhaps in some cases it would be more profitable to roast the ore to remove the sulphur before commencing chloridizing volatilization. In cases where the chloride fume is caught dry, as in a bag-house, it can be treated by means of wet methods to separate and recover the metals, or the product can be smelted with an alkali or an alkaline-earth carbonate and carbon to produce bullion and an available chloride. The selection of the best means of collecting the fume and treating it, as well as the mode of application of chloridizing volatilization, depends a great deal on the character of the ore and

the local conditions under which it is necessary to do the work.

The proper degree of grinding to be applied to an ore will depend upon the character of the ore itself, the chloridizing agent, the type of furnace, and the method of applying the chloridizing agent. When sodium chloride was used I obtained better extractions from some ores when ground to pass a $\frac{1}{4}$ -inch aperture than after finer grinding. I found that the ore heated quicker and that it sintered less when coarsely ground.

The manner of applying the chloridizing agent will also depend upon the ore and to a smaller extent upon local conditions. The chloridizing agent may be added in a solid form or it may be added as a solution. Except where fuel is expensive or water scarce, it will be advisable, unless possibly the ore is to be pre-roasted before being subjected to chloridizing volatilization, to crush the ore in solution, then de-water to a desired point, say, where the proportion of solution retained is sufficient to provide the proper amount of chloridizing agent. The thickened pulp may then be fed to a suitable dryer, such as, for example, a double-action broken-flight conveyor by which ore is dried as much as desired and the lumps broken up. Such a drier could be heated by means of the flue-gases from the furnace. The ore could then be fed to the furnace. Grinding in solution will reduce the cost of grinding by about 50%; it will prevent the dust nuisance; it will cause less loss by dusting in the furnace; it will save chloridizing agents; it will ensure a perfect mixture of chloridizing agent and the ore, thereby ensuring good extractions; and it will increase the extraction in oxidized lead ores because lead is dissolved by the chloride solution, and it can then be recovered from the decanted solutions by precipitation. In cases of oxidized lead ores chloridization will be almost complete before the ore reaches the furnace. Ores will settle well from saturated calcium-chloride solutions, especially if sodium chloride is present. A saturated solution of calcium chloride will contain 40% CaCl_2 , equivalent to about 53% $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$. I have experimented with the Cerro Gordo dump-ore, which contains considerable dust and which is somewhat similar to the ore quoted above, but of somewhat lower grade; this ore when ground to pass 10-mesh will settle readily, in calcium-chloride solutions containing a little sodium chloride, to a pulp containing less than 20% solution. On drying such a pulp (containing 20% saturated solution) down to near the point of crystallization of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, it would be necessary to evaporate 180 lb. of water per ton of ore. The dried mixture would contain about 10.6% $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, which is more than sufficient for treatment of the ore by chloridizing volatilization. The flue-gases would contain more than sufficient available heat with which to drive off the small amount of water. In this particular case, over 50% of the lead and some silver would be recovered from the decanted solutions. On this ore I have repeatedly obtained over 98% of the silver, lead, and gold contents by chloridizing volatilization. Assuming the improbable, that only 75% furnace extraction of the lead could be

obtained, then, if 50% were extracted by solutions and 75% of the remaining by volatilization, the total extraction would be 85%.

The consumption of chloridizing agents will not be a serious item of cost in the process, because there is little chance for stack-losses, especially if an absorbent like calcium carbonate is used. The combined chlorine can nearly all be recovered in an available form and most of the chlorine is driven from the ore before it is discharged. An allowance of 10% of the chloride added to the ore would in most cases cover the possible losses. The amount of chloride required by the ore will vary with the character of the ore, the type of furnace, and the nature of the chloride, as well as the manner of applying the chloride. The amount added to the ore may vary anywhere from 1 to 12% or more of the weight of the ore; therefore, the loss would not exceed, say, 20 lb. per ton of ore. In most cases it will be found advisable to work with calcium chloride and in many cases the small losses of the chloride can be made up with a cheap salt, like sodium chloride, which may be added to the charge fed to the furnace. Saturated or nearly saturated solutions of magnesium chloride would be cheap where freight-rates are not prohibitive, as they can be purchased from ocean salt-factories for a few cents per gallon loaded on board tank-cars. The problem would be to get the tank-cars.

In some cases chlorine gas may be used as the chloridizing agent to advantage; for example, in the case of ores that tend to fuse when an alkaline chloride is used.

While chloridizing volatilization will find a big field in complex ores, it may also be used on simple ores, like a straight precious-metal ore, as the cost of operation is not high. On an oxidized silver tailing from pan amalgamation, in which the silver was combined with manganese, and in which no lead or copper was present, and, further, in which the gangue consisted of silica and barium sulphate, I have obtained 80% extractions on the first trial, whereas the best extraction that could be obtained either by cyanidation, concentration, or flotation, or by all three methods, was not much over 50%. The estimated cost of treating this tailing by chloridizing volatilization in a 50-ton plant was \$2.43 per ton.

The possibility of obtaining preferential extractions, say, of silver in a silver-lead ore, during volatilization is indicated by tests on an ore which, when 10% chloridizing agent was used gave over 80% of the silver and lead, and which, when only 4% chloridizing agent was used, gave over 80% extraction of silver and 37% of the lead.

Sintering or the formation of fusible silicates hinder extraction, but lead extractions usually suffer more than silver extractions in such cases. As a rule alkaline-earth chlorides will give better results even at lower heats than will sodium chloride.

The temperature required will vary according to the altitude, class of ore, chloridizing agent, and type of furnace.

The cost of the plant varies, of course, with local conditions, but a plant of 50-ton daily capacity could probably be erected at a cost of about \$750 per ton-capacity.

The Homestake Fire of 1919

By R. G. WAYLAND

*The early mining on the Homestake orebody was done with the square-set system and an enormous quantity of timber was used. This system has been discontinued in carrying up the stopes, and shrinkage stoping is employed from the sill-floor up to a point 25 ft. below the next level, leaving a crown of ore above each stope. After the broken ore is drawn and sent to the mill, a timber mat is laid on the sill-floor and the empty stope is filled with waste from the level above. Subsequently the pillars and crowns are removed by square-set stoping and filled with waste.

The fire, which is now† burning at the Homestake mine, started on the evening of September 25, 1919, above the top (sixth) floor of one of the small square-set stopes in No. 3 pillar north of the Star cross-cut on the 800-ft. level.

This stope had broken into a large area of broken ore, waste, and timber above the 700-ft. level, and the night shift was engaged in drawing this ore. The broken ore and timber had arched over and hung up about 30 ft. above the grizzly, and in blasting it down the men set fire to some of the timber. They immediately tried to draw this burning timber out, but failed, and steps were at once taken to pipe water into the stope from the 800-ft. level.

Smoke and gas from the burning timber soon rendered it impossible to work in the stope without rescue apparatus and the gas was spreading to other parts of the mine. Therefore, the work of building brattices to isolate the fire area was commenced at once. Wooden brattices, plastered with cement, were built in all openings into this part of the mine on the 600, 700, and 800-ft. levels. The increasing volume of smoke and gas soon made it necessary to use oxygen apparatus in this work also. Later it was necessary to build brattices on the 900, 1000, and 1100-ft. levels as well.

At the same time, pipe-lines were laid on the 600 and 700-ft. levels, and the area immediately over the fire was flooded with water. On the 600-ft. level a cross-cut was driven from the foot-wall into the caved ground above the fire and an attempt was made to drive a pipe ahead to a point directly over the fire and turn water into this cavity. This work was done under the direction of the Bureau of Mines engineers. Two short headers were driven on the 700-ft. level in an effort to get near the fire, and in one of these some burning timber was encountered and extinguished, but without effect on the main body of the fire. This is the only instance in which fire was actually seen since the first night.

Chemical apparatus from the Lead City fire department was used at this point and a stream was kept playing for about 24 hours without any tangible result.

*From the 'Pahasapa Quarterly'. The author is chief engineer for the Homestake Mining Company.

†The fire was extinguished early in December.

In the meantime, car No. 5 of the Bureau of Mines had arrived at Lead and its crew was giving every aid in the helmet work and in devising means for combatting the fire.

On October 5, after a conference of department heads, it was decided to hang up the mills and flood the mines. On October 7 the first 12-in. pipe-line began to flow into the open-cut and on the 9th the second one. These pipe-lines were each 600 ft. long and were laid on the surface of Mill street from a point in front of the general offices into the open-cut.

A 3200-ft. flume was also constructed along the side of Whitewood creek from a point a short distance below Kirk to the mouth of Savage tunnel, which connects with the 300-ft. level of the Homestake mine. Water was turned into this flume on October 12. Water flowing in Deadwood gulch at Central City also was caught and pumped into the mine. The Golden Reward mine at Aztec, at the head of Whitewood creek, was equipped with skips and is being unwatered, the water flowing into the Savage tunnel, three or four miles downstream. The total amount of water running into the mines is about 1300 cu. ft. per minute, and the total volume to be filled is about 100,000,000 cubic feet.

Concrete bulkheads have been built in all the openings from the Homestake mine proper into the Caledonia workings, so that these workings will not be flooded. The bulkheads were designed to stand pressure that would result if the mine were filled to the 300-ft. level, and a large factor of safety was used. The lowest bulkhead is on the 900-ft. level and is nine feet thick; those on the 800-ft. level are six feet thick; the rest are five feet. In all, 11 bulkheads were built.

The concrete was mixed in a revolving mixer on the surface and transported in mine cars down the shafts to the various bulkheads. After the forms had been removed from the concrete a finishing coat was troweled on.

All electrical machinery, drilling machines, locomotives, and everything that the water would damage was removed from the mine and the levels were thoroughly cleared of trash, stray timber, and anything that could float about and cause damage. The shaft openings have been laced to keep timber from floating into them and interfering with the skips or cages.

As soon as the water is high enough in the mine the work of unwatering will begin. The main dependence will be placed upon water skips operated by five of the hoisting-engines, and upon air-lifts. The pumps will, of course, also be used as soon as it is possible.

Stamps will begin dropping almost as soon as the work of unwatering is started; and long before the mine is entirely pumped out normal production will have been reached. The company has been able to keep all of the mine and mill crews employed on the needed surface improvements and exploration work, so that the fire has had little effect upon the community.

Fighting the fire has entailed a great deal of hard, disagreeable, and hazardous work, but the mine crew has undertaken it willingly and carried it out with great resourcefulness.



THE LA PAZ MILL



THE ESMERALDA MINE

Mining and Smelting Near Matehuala, Mexico

By R. B. BRINSMADE

To reach Matehuala one leaves the main line of the Laredo-Mexico City or National railway at the station of Vanegas and proceeds by a branch line for 30 km. south-eastward. The city itself has the typical flat-roofed structures of the Mexican plateau and, beyond its smelting industry, has little to distinguish it from scores of other towns of a few thousand inhabitants. I shall first describe the American Smelting & Refining Co.'s smelter, and then give a few notes concerning the neighboring mines, which furnish the bulk of its ore-supply. These are situated at La Paz and Catorce in the mountain range lying west of Matehuala and east of the main line of the National railway.

SMELTER. The smelting is done entirely in blast-furnaces, of which there are three of different sizes, the principal dimensions being as follows:

Furnace	Daily capacity Tons	Hearth at tuyeres		Number of jackets		Fore-hearth	
		Length Ft.	Width Ft.	Each side	Each end	Diam Ft.	Height Ft.
No. 1. . . .	150	7½	4	3	2	14	5
No. 2. . . .	250	12	4	4	2	14	5
No. 3. . . .	450	20	4	8	4	18	5

The cast-iron baseplates of the crucible of the largest furnace rest on 18 cast-iron posts, whereas those of the smaller furnaces are supported by the usual jack-screws. The feeding is done by hand, through long doors on each side of the smoke-hood, from buggies that have been filled at the ore-beds and raised to the feed-floor level by a hydraulic elevator. The column of ore is run 9 ft. high above the tuyeres and the consumption of coke is 10% on the charge, as most of the ore is oxidized and only enough sulphide is fed to make the matte to catch the gold, silver, and copper. The blast-pressure is 24 oz. per square inch. It is furnished by two Connellsville cycloidal blowers, one making 67 and the other 100 cu.

ft. per revolution, belted to a Bass 180-hp. tandem-compound engine. As a relay is a Root No. 10 cycloidal blower direct-connected to a Nordberg tandem-compound engine of 200 horse-power.

Slag from the furnace flows continuously to a cylindrical steel fore-hearth lined with firebrick and water-cooled by jets from an exterior ring of 1-in. pipe set 1½ ft. below the top rim. From the fore-hearth the slag overflows to Nasmyth slag-cars, which are hauled by electric-trolley locomotives to the dump. The matte settles in the fore-hearth and is thence tapped into cast-iron molds with ellipsoidal bottoms, 6½ ft. long by 2½ ft. wide by 1½ ft. deep, set on four wheels and holding 650 kg. When solid, the matte is dumped from the molds to the ore-bed level, where it is sprinkled with water and broken into lumps, for return to the furnace, until it runs high enough in sulphur for shipment. This means 42% sulphur, the first matte having some 10% less.

The supply of copper ore comes chiefly from the Dolores and the dry pyrite is a silver ore from the La Paz mines. When larger than a fist it is passed through a jaw-crusher; otherwise it is dumped directly from the barrows, which run on plank-platforms, at the level of the railway-car floors, over the ore-beds. The sample is obtained by taking every tenth shovel or so, when unloading the railway-cars, and wheeling it in barrows to the sampling-mill. Here the sample passes from a jaw-crusher, a bucket-elevator, and a Vezin automatic sampler into a pair of rolls. The discharge from the rolls is quartered on an iron plate to assay size by aid of a hand-sieve and a pair of fine rolls. The ore-beds have flat floors and are surrounded by walls of slag-brick.

Power is supplied by five horizontal boilers; of these three are of the return-tubular type, 5 ft. diam. by 18 ft.

long, and two are Hazleton patent boilers, 10 ft. diam. by 18 ft. long, each with a single internal corrugated flue in the lower half of the shell and a set of return-tubes in the upper half. As in the blowing-plant, the direct-current electric generators are in duplicate. The first set is a General Electric dynamo of 125 volts and 800 amp., direct-connected to an Ideal high-speed engine of 260 r.p.m. The relay set consists of two Wood dynamos, one of 40 and one of 25 kw., belted to an Atlas slide-valve engine. There is also an ice-machine, belted from an electric motor, with a capacity of one ton per day. Part of the ice is used for drinking-water, the remainder being sold in the city.

This plant has to do its own repairing, so the shops are correspondingly complete. The smithy has four 4-ft. forges and a shear-press; the machine-shop has two lathes, a planer, a shaper, a drill-press, an emery-grinder, a grindstone, and a pipe-machine.

To catch the blast-furnace dust, there is an extensive flue system. First the furnace down-comers pour some 90% of the dust into a brick settling-chamber, the floor of which is arranged in a line of hoppers that can be spouted direct into a small car. The smoke then passes into twin flues, either of which can be cut off for repair or cleaning by a steel drop-door at its entrance. For the first part of their length, the twin flues are 16 ft. high and have a longitudinal arched roof supported by tie-rods and buckstays; for the last 100 m. or so they are 20 ft. high and have a roof of transverse jack arches. The flues have flat floors, which can be cleaned through small doors on their exterior sides. Finally the smoke escapes through an octagonal brick stack, 16 ft. inside diameter by 250 ft. high.

Altogether, the Matehuala plant is satisfactory for its purpose, which is the smelting of large quantities of low-grade copper ore, mostly oxidized and coarse, for the production of a copper-matte that serves meanwhile as a collector for dry silver ores, some of high grade. It was built by the National Metallurgical Co. under the direction of G. B. Ladd of Pittsburgh, and was acquired by its present owners in 1910.

WATER-SUPPLY. Formerly the population of Matehuala were frequently forced by thirst to migrate during the dry season, but this scarcity of water was remedied as a preliminary to the construction of the smelter. By an expenditure of \$360,000, the only mountain stream in the vicinity, for a long radius, was secured at Maroma, whence it is brought to town in a 30-km. canal, the minimum supply being 400 gal. per minute.

POWER-PLANT. Adjoining the smelter is the power-plant of the Dolores copper mine of the A. S. & R. Co., situated eight miles away on the company's narrow-gauge steam-railway. The plant is one of 300 hp. and has two Erie City water-tube boilers, fed by Knowles pumps with water from the tower outside, which cools the condensed steam from the engines. There are two Nordberg tandem-compound Corliss engines, each belted to a General Electric three-phase generator of 600 volts and 242 amperes. The resulting alternating current is stepped

up to 10,000 volts for transmission and reduced at its terminal to 440 volts for mining purposes.

THE MINES OF LA PAZ. This district has two distinct classes of deposits: contact masses of copper ore and fissure-veins of silver mineral. Of the former, the chief shippers are the Dolores and the Cobriza; of the latter, the Santa Maria de La Paz, the Nueva Paz, and the Esmeralda. Other less developed mines are the Maria Luisa, the Augustias, the Perla, the Santo Niño, and the Rubi.

The Dolores mine was acquired by its present owners in 1901 and was developed for several years with a force of 2000 to 3000 men. When it reached the productive stage it was found that 700 men sufficed to get out a daily shipment of 500 tons. Whenever required, the orebodies can easily yield double this quantity.

The geology is sketched in plan and section in Fig. 1, which shows a limestone hill intruded by a laccolith of monzonite-porphyry. The Dolores porphyry shows in the plan as a triangle whose sides are designated as the North contact, the South contact, and the Fault. The last has a down-throw on its east side, where lie the fissures of the silver zone. The South contact follows the direction of the limestone beds but the North contact cuts across them. The orebodies lie along the contacts and are large for this type, one having been found 300 ft. long, 70 ft. thick, and over 300 ft. deep. As the North contact of the Dolores property is a half-mile long, the South contact nearly as extensive, and there are also several limestone horses, occurring in the laccolith, where contacts may likewise contain lenses of ore, it is evident that the area favorable to exploration is immense. The contact zone is highly metamorphosed into a hard crystalline mass of garnet, chalcedony, wollastonite, epidote, and hornblende. Where replaced by ore the contact rock shows azurite, pyrite, and chalcopyrite, and the commercial product runs 40% silica and 3% copper, with $2\frac{1}{2}$ gm. of gold and 70 gm. of silver per metric ton. Originally the ore was shipped to Aguascalientes for smelting, and then only a sorted grade going 5% copper was payable, but since the purchase of the Matehuala smelter the shipping grade has been reduced to 3%.

The mine is opened by a vertical shaft from the surface and by two cross-cut adits, one on the South and the other on the North contact. The main shaft has two compartments, equipped with balanced two-ton skips, and is over 100 m. deep. The South adit is double-tracked and connects with a two-compartment vertical shaft also furnished with two-ton skips and over 100 m. deep. The North adit has a like shaft but with a third compartment for a ladder-way. These shafts are driven in self-sustaining rock and are consequently only timbered enough to hold the skip-guides and the ore-bins at the levels placed at 100-ft. vertical intervals.

The shafts are fitted with Wellman-Seaver-Morgan second-motion electric hoists of 125 hp. each. These have inch ropes with a maximum speed of 500 ft. per minute, wound on double 5-ft. drums. The motors are General Electric of 440 volts and a three-phase current. These

electric engines were put in a decade or so ago to replace smaller gasoline prospecting hoists. The electric current, which arrives from the generating station of Matchuala at 10,000 volts and is stepped down to 440 volts at the mine, also drives an Ingersoll-Rand air-compressor capable of supplying twenty-five 3-in. piston-drills at 80 lb. pressure. This machine is turned by a constant-speed synchronous motor and its air-cylinders are cross-compound, equipped with the piston-intake and an automatic release. This last opens two relief-valves when the air-receiver is overloaded and prevents the pistons from doing aught but churn the air.

Before the installation of this air-compressor, in 1911,

plays his assistants on day's pay, which is advanced by the company, as the work progresses, and deducted from the contract price on the day of settlement.

Every mine-car is sampled before dumping, and, unless all the cars from a stope are up to the required grade, the foreman also samples the face, as its appearance alone is an uncertain guide. In the assay-office, the mine-run samples are only tested for copper, because each per cent of copper means 0.8 gm. of gold and 23 gm. of silver per metric ton.

In hand work, the progress is so slow that little powder is consumed and artificial ventilation is therefore unnecessary, while in development by power-drills the compressed air suffices to blow out any excess of smoke. Likewise little or no pumping is required, as the natural fissures of the contact formation suffice to keep the workings dry in this region of small rainfall. Indeed, water is so scarce locally that a considerable quantity for domestic and mining use is brought in daily on the railway from Matchuala.

The company provides a doctor and hospital for its

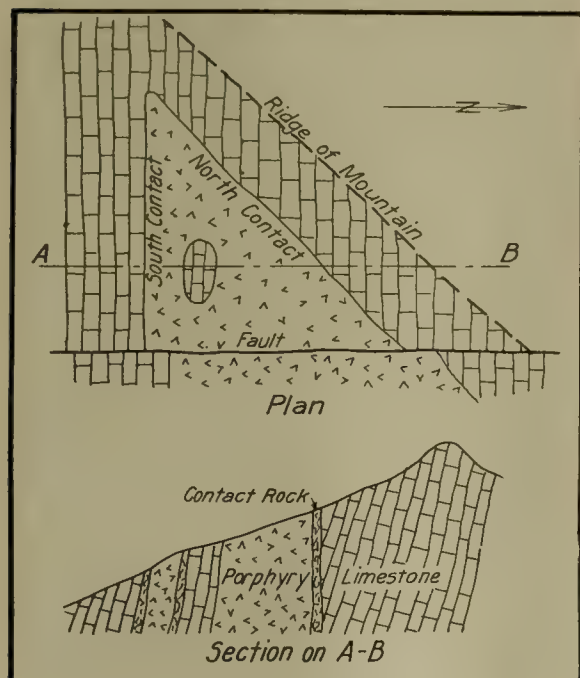


FIG. 1

all development was done by double-hand drills and was extremely slow, as a gang could only drill a metre of inch holes in contact-rock and two metres in limestone per shift. This meant a weekly advance of $1\frac{1}{2}$ to 3 metres, when working two gangs at the face of a tunnel 2 m. high by 1.8 m. wide on each of the two daily shifts. With air-drills, this speed can be quadrupled and often quintupled.

Tramming is done in Koppel side-dump steel cars, holding 840 kg. and with wheels shrunk on the axles, which run in outside boxes as in railway practice. All tramming is done by contract under direction of the company's boss. In fact, the contract system is generally used for all labor in the mine except skip-tenders and hoisting-engineers. The development is paid by metre of advance and the stoping by the ton broken. The company furnishes the contractors everything free, except explosives, which are sold at cost. Generally one contractor has charge of only one heading or stope and em-

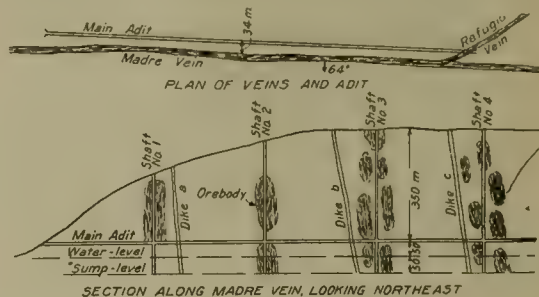


FIG. 2

employees, who are entitled to free treatment and an allowance of money during illness by the payment of a small monthly contribution to the hospital fund. Besides an American foreman, practically all underground men are Mexicans. The official staff, which includes a superintendent, a doctor, an assayer, and a surveyor, was all American at the time of my visit.

The Dolores mine is probably the best example of a copper mine in a lime-porphyry contact formation in the eastern Sierra Madre. In the large size of its orebodies and in the nature and grade of its output, it is strikingly similar to the mines of the Suan Concession in Korea.* Here, however, the area of productive contact is considerably smaller and the altitude above sea-level much higher than in its Korean counterpart.

SANTA MARIA DE LA PAZ. This mine is owned by a native company, with many French stockholders; it also owns the neighboring Nueva Paz mine. The shares are quoted on the Stock Exchange in Mexico City; the company has paid a large sum in dividends from an output of rich ore extending over many years. Quite unlike the adjoining Dolores mines, its deposits produce principally silver and gold from fissure-veins along porphyry dikes, of which there are two series: the first running from

*M. & S. P., Oct. 11 and 25, 1919, pp. 509 and 599.

north-east to south-west, and the second from east to west. The main orebodies are found along the foot-walls of the first system of dikes and occur in vertical shoots 50 to 80 m. long and $\frac{1}{2}$ to 3 m. wide, following the dip of the porphyry, which is 60° to 70° south-east. The best bonanzas in size and grade are found at the intersection of two dikes of different strike. A short distance east of the fault shown in Fig. 3 is another fault, and this latter forms the western limit of the dikes that cut the slates, schists, and limestones in the La Paz property. In depth, the orebodies are apt to be of lozenge shape and to occur *en echelon* along the propitious fissures, as in Fig. 2.

The ore is hard, with a gangue of calcite and quartz, and contains some galena, pyrite, and sphalerite, with a little chalcopyrite, besides the sulphides and sulpho-antimonides of silver that furnish most of the yield. The Santa Maria mine is opened by a vertical shaft over 500 m. deep and ships its high-grade ore to the lead smelters at Monterrey, while its common ore goes to the Matehuala copper plant. For seven years previous to 1904, the mineral output was treated in a plant at the mine, the greater part of which was still preserved at my visit, for use in emergencies.

The Santa Maria reduction works consist of a concentrating mill and a lead smelter. The mill contains a jaw-crusher, two sets of rolls, 11 Wilfley tables, and one Wilfley slime-table, besides two bucket-elevators and the necessary bins, sluices, etc. It was run by a small simple horizontal steam-engine fed by the boilers supplying the smelter. This mill evidently handled the low-grade ore to make table and slime concentrates to feed the smelter.

The smelter has three roasters and three blast-furnaces for making lead bullion. The roasters are built of the local porphyry and sandstone, with firebrick only for lining the arches and doors where high temperatures prevail. The hearths are 16 by 50 ft. and their smoke passes to a dust-flue, with adobe-brick walls and a roof of flat cast-iron plates with no buckstays, debouching into a stack built of red brick and 60 ft. high. The dust-flue is $3\frac{1}{2}$ ft. wide by $5\frac{1}{2}$ ft. high inside and its 20-in. adobe walls are protected by a stone coping, 12 in. wide, between which the iron roof-plates are set.

Of the blast-furnaces, the two older ones are of round section, 4 ft. inside diam. at tuyeres, and provided with four cast-iron water-jackets, $4\frac{1}{2}$ ft. high, in which are set seven 3-in. tuyeres. The newest furnace is rectangular and has two tiers of four cast-iron jackets on each side and two at each end, with six 3-in. tuyeres on each side. Above the jackets, it has the usual brick shaft resting on a base of I-beams supported by cast-iron posts. The furnaces are hand-fed and their smoke debouches into an adobe dust-flue of similar construction, but of larger size, to that used by the roasters. For blast, there is a cycloidal positive blower, belted to a Ball high-speed engine, to supply all three blast-furnaces.

ESMERALDA MINE. This property, also owned by a native company, lies just east of the La Paz mine and has opened five ore-shoots along one of the north-east systems

of dikes already mentioned. These shoots are still strong at the bottom of the La Cruz shaft, which is over 500 m. deep. The country-rock here is entirely limestone and the ore-shoots lie between it and the floor of the dike. At the time of my visit, 400 tons of ore was being shipped per week with an average assay of 1.2 kg. silver per ton. Of this ore, the first-class, going 2 kg. and up, went to Monterrey, while the second-class, going around 0.8 kg., went to Matehuala. The vein-minerals are the same as those in the La Paz mine.

The steam for the power-plant is furnished by three return-tubular boilers, each of 150 hp., made by the Ames Iron Works of Oswego, New York, and fired by domestic coal. The air-compressor is of Laidlaw-Dunn-Gordon make and of 125 hp., making 1500 cu. ft. per minute; it has cross-compound air and steam cylinders and runs only the underground hoists and pumps, drilling being done by hand. The shaft head-frame is of two-post wooden type; and the steam second-motion hoisting-engine is of German make and of 80 hp., with two independent drums of 2 m. diam. which handle two one-ton buckets, in counterbalance, by a $\frac{3}{4}$ -in. rope.

THE MINES OF CATORCE. Outside of Pachuca, this district has probably produced more silver than any of its rivals in the eastern Sierra Madre. It lies on the western flank of the mountain range that contains La Paz, which is 12 miles away as the crow flies. It is reached by a wagon-road from the station of Catorce on the National railway. Leaving this valley station at an elevation around 6000 ft., the road becomes steeper and steeper as it ascends the mountain slope, finally following long sweeping curves blasted from the canyon-walls in so costly a fashion as to bespeak the ancient importance of the mines above. Twelve miles from the railway the city of Catorce itself is reached at 9540 ft. elevation, and its hundreds of snug adobe and stone houses, mostly vacant, denote the chill of the climate and the modern somnolence of the camp, a sad condition which the recent rise in the price of silver may do much to correct.

As Mexican mining districts go, Catorce is quite young, not having been discovered till 1773. Its surficial ores were immensely rich in hornsilver, and from 1778 till 1810, when the War of Independence stopped production, the gross output was over \$4,000,000 per annum, or a total for 32 years of at least \$128,000,000. Even in 1810, many of the best mines had reached water-level and sulphide ore, and after the expulsion of the Spaniards most of them remained closed for many years. In 1826, an English company installed a Cornish pump and reopened the Concepcion mine, but the pump was burnt out after a few years and little was done thereafter till in 1882 a native syndicate succeeded in unwatering part of the workings. This syndicate produced largely till 1897, when the mine was again flooded, owing to the pumps being stopped on account of the low price of silver.

Along the wagon-road from Catorce station to Catorce city are two deserted towns, formerly inhabited by the mill-hands who worked the patio process along the gulch

on the ores from the mines above. Soon after the railway reached Catorce station, 35 years ago, the richer ore began to be shipped to the Monterrey lead smelters. Since smelting began at Matehuala, the Catorce shipping ore has been packed over the mountain ridge to the east and carried 21 miles to Cedral station for smelting at Matehuala. The creek in Catorce gulch, which formerly watered the patios, now furnishes irrigation for small gardens along its banks and for some meadows near Catorce station, where fodder for the pack-animals supplying the mines is raised.

Going east from Catorce station, the wagon-road to Catorce follows the valley for half the distance and is now so out of repair as to be practicable only for pack-animals. At its mouth, Catorce gulch shows itself as an eroded anticlinal fold in blue limestone, interlined occasionally with red and green shale. Half-way up the gulch to the town, large cliffs of red andesite begin to appear beneath the limestone crests of the hills, and frequent dikes of greenish diorite and light-colored porphyries are seen.

The mines lie east of town, toward the summit of the Catorce range, and occur as fissure-veins in limestone, wherever it is intruded by porphyry dikes. The ore deposits are thus, geologically, similar to the silver veins of La Paz, across the range. The Santa Ana mine is the best equipped property in the district; it has a coal-burning steam-plant supplying electric pumps and hoists installed at a cost of 2,000,000 pesos. At the time of my visit, it was the only mine that was pumping and able to extract ore below the level of ground-water. It employed 200 men and ran a horse-tramway from Catorce to the mine, a half hour's ride, for its employees. Only discovered in 1870, it has produced much oxidized ore and is now finding rich silver sulphide below the water-level. There are many other old mines, some of which have been idle for decades, owing to the expense of pumping and the cheapness of silver, that will undoubtedly be resuscitated if silver continues at its present price. Such are the Valenciana, the Dolores, the Sirena, the Boquero, the Guadalupe, the Prisca, the Padre Flores, the San Agustín, and the Purisima.

CONCEPCION MINE. As already noted, this property has been one of the most productive of the district, and, after more than a century of sporadic activity, has good future prospects. As sketched in Fig. 2, there is one fissure, called the Madre, and one developed branch, the Refugio, both opened by the main drainage-adit, a mile long and 350 m. vertically below the crest of the outcrop workings at shaft No. 3. The vein is 20 m. thick and dips 64° south-west, while the limestone beds dip 30° north-west. The vein-filling is quartz and calcite except in the ore-shoots, of which there are four developed in the length of the adit and pierced by the shafts at 1, 2, 3, and 4 in Fig. 2. The distribution of these ore-shoots is apparently controlled by porphyry dikes, which cut the vein at intervals, dip sub-vertically, and are 5 to 20 m. thick. In Fig. 2, only the three principal dikes are shown at *a*, *b*, and *c*, and it can readily be seen that they

follow closely the biggest ore-shoots, at 1, 2, and 3 respectively.

The ore-shoots are not continuous chimneys, but rather form a zone of lozenge-shape lenses, $\frac{1}{2}$ to 10 m. thick and occurring anywhere between the vein-walls. They often reach a length of 80 m. and a height of 100 m., and are apt to occur *en echelon* as shown in Fig. 2. The ore-minerals are cyrargyrite, hematite, pyrolusite, and a little malachite in the oxidized zone, which extends to water-level at 400 m. vertically below the collar of the General or No. 3 shaft. Below this is a rich secondary zone of the sulphides, sulpho-antimonides, and sulpho-arsenides of silver with pyrite and sphalerite. The richest ore, often 500 oz. per ton, was found in the big lenses of shoots No. 3 and No. 4, while much ore of the lenses at No. 1 and No. 2 only assays 20 oz. At my visit, 100 men, by hand-drilling only, were getting out 30 to 50 tons weekly of sorted ore going 40 to 80 oz. of silver per ton. This was oxidized ore gleaned from the old stopes above the adit-level (as pumping the workings lower down had ceased in the 'nineties) and trammed to the mouth of the adit.

For handling the ore when working below the adit-level, there is a 200-hp. steam-hoist at No. 3 shaft; this operates two balanced buckets of two-ton capacity. As relays are two 30-hp. hoists. The surface hoists and a 100-hp. air-compressor, for mine and hoists, are supplied with steam by seven 80-hp. boilers of the horizontal return-tubular type.

The mill is a concentrator for the treatment of sulphide ores. It is equipped with a 25-hp. vertical boiler, a 15-hp. horizontal simple engine, a 10-stamp battery, built by the Pacific Iron Works, a 4-ft. Huntington mill, a two-compartment Harz jig, a 3-ft. two-field trommel, 6 Wilfey tables, and two Frue vanners. As this plant made a poor saving even on sulphides and was useless for oxidized ores, it was planned to transform it into a cyanide-leaching mill. The ore above a 40-oz. grade would then be still shipped to Matehuala, but the poorer quality of oxidized ore could be profitably leached. To reduce the cost of power, two choices were open: the first to buy electricity from the adjoining Santa Ana plant, the second to install gas-engines and supply them by coal-burning gas-producers.

AMERICAN SHEET ZINC, in exact sizes and properly marked, should be in good demand in European countries. Present conditions even favor the introduction there of American finished roofing plates. It has recently been shown that American machinery for this purpose can be much more economically operated here than that now in use on the continent. The largest use for sheet zinc in Europe is, of course, in building construction, and, strange as it may be, this field seems to be capable of worth while expansion by the United States. The American Zinc Institute is adopting publicity methods which have made so general the use of zinc construction in Europe, explaining that zinc is moderate in cost, light, easily worked, and long lived.

Tungsten in China

Tungsten mines in China were discovered only recently in deposits in the southern part below the 30th degree of north latitude. At the present time, with a few exceptions, the mines are not owned by any private companies or by the Government, but anyone may employ men to work a mine. The principal districts in which tungsten is found are in the Province of Hunan (southern part), in Hangchow and its vicinity; Kiangsi (southern part), in the Lunghansien, Tinnan, Sinfenghsien, Nankanghsien, and Taiyu districts; and Kwangtung (eastern part), in the Wuwha, Hingninghsien, Kaiyung, Heifung, Lukfung, and Wailia districts, (northern part), in the Nanyung, Lokchong, Chihing, and Chukiang districts. The districts mentioned above are only those in which operations are now being carried on, there being other large areas in which tungsten deposits are found, in the southern parts of the Provinces of Hunan and Kiangsi and the north-eastern part of Kwangtung, which have not as yet been opened.

Chinese tungsten, in the form of wolframite, occurs either as sands or pebbles in the streams or in small veins in the granitic rocks. The former deposits are sometimes accompanied by cassiterite or magnetite, or both, usually mixed with quartz sands, the latter in the form of veins ranging in thickness from a fraction of an inch to 2 or 3 in. Although both kinds of deposits are found in many widely scattered regions, they are never found in large quantities in any particular area. For this reason, and also because this industry is of very recent origin in China, no modern systematic methods have been inaugurated to explore this field.

Rakes, toms, and pans are used for washing the stream ores, while in the case of vein ores, hand-hammers, drills, and sometimes black powder are used for extracting the ore. With the exception of a few places in Hunan and Kwangtung, nearly all the mining is carried on by farmers, who work during their spare time after their farming labor is completed. But during the early part of 1918 the industry had grown to such an extent that many of the farmers suspended their farm work and devoted themselves entirely to tungsten mining.

The concentrate offered on the market is rather impure, and usually must be reconcentrated for export purposes. For this purpose a few native, as well as foreign, companies have sprung up, each having a concentrating plant of some sort. The Yui Hwa Mineral Supply Co. has a fairly well-equipped plant, containing shaking-screens, jigs, rocking tables, and round revolving tables for concentrating its own ores and those collected from mining centres; and it is in a position to produce concentrates of 67 to 72% WO_3 with about 5% of manganese and containing but a small amount of impurities such as copper or tin.

The farmers take their concentrate to the local market where they dispose of it to local dealers at the best prices obtainable. The local dealers, in turn, sell to licensed collectors from the ports. The port dealer has to pay

a tax to the Government, and, after shipping the concentrate to his own port, he is under obligation to export it within a certain period, usually three months. If he fails to do this he is obliged to get another license for the same ore or forfeit the ore to the Government.

According to the statistical abstracts of the year 1918, as prepared by the Chinese Maritime Customs, the total exports of tungsten ore amounted to 10,365 short tons. However, the total production for the year 1918 exceeded this figure, there being large quantities left in the mining districts which could not be sold owing to the cessation of hostilities in Europe. The working of the deposits continued, nevertheless, until February 1919, when the operators saw that the returns would not even pay their workmen. It is stated that mining operations cannot be resumed unless the market price is high enough to enable operators to pay each workman 20 tael cents per day for his labor. The following is an estimate of the cost of placing a short ton of concentrate on the market. The average rate of exchange in 1917 was \$1.08 gold, and in 1918, \$1.193 gold. The rate in the latter part of July 1919 was \$1.37 gold.

	Taels
Cost of extraction	300
Cost of transportation	40
Customs duties, license fees, local taxes, etc.....	100
Cost of insurance and incidental charges.....	20
Total cost	460

The above figure was arrived at by estimating the cost of labor at 20 tael cents per workman per day. Each workman can extract about $1\frac{1}{2}$ lb. of ore per day. The cost of transportation covers the cost from the mines to Shanghai or Hongkong. The export duty on every ton of ore is about 15 taels; local taxes and license fees amount to 85 taels.

The market prices since the outbreak of the War were as follows: War-time prices, 800 to 1000 taels per ton; November 1918 to January 1919, 500 taels per ton; January 1919 to August 1919, no market in Shanghai and Hongkong, only a few transactions having taken place in Canton and Swatow at prices varying from 350 to 250 taels per ton. As evidenced by these figures, the signing of the armistice caused an almost complete stagnation of the market, which resulted in the cessation of all mining operations.

Up to August 1919 tungsten ore was wholly an export product. China has no way of utilizing the ore. A plan was formulated last year for establishing a plant at Hankow for making ferro-tungsten, but the scheme was postponed on account of the inactivity of the tungsten market. It is understood that there is a small smelting plant at Dalny, which, however, is still in an experimental stage.

It is difficult even to estimate approximately the quantities of future production for any definite length of time, as, thus far, no authoritative survey has been made of this field in China. It is estimated that all the mines in the above-mentioned districts are capable of equaling their production during the year 1918 for more than 10 years. Future shipments abroad will be governed entirely by the demands of the American and European markets.

Metal Production in California for 1919

By CHARLES G. YALE

*The output of gold, silver, copper, lead, and zinc from metal mines in California in 1919 was valued at \$23,124,045, as compared with \$31,187,807 in 1918. This is a decrease of \$8,063,762, or 26%.

GOLD. The mine output of gold for the State in 1918 was \$16,528,953. The estimate for 1919 indicates a production of \$17,320,250, which is about \$791,300 more than in 1918. Although the conditions for gold mining continue to be unfavorable, some such increase as this was to be expected in view of the fact that the decrease in the gold output in 1918, as compared with 1917, was abnormally large. The decrease in 1918 was \$3,558,551, the largest in many years, so the increase for 1919 merely shows that mining in California has begun to readjust itself to the present general conditions, and in a few years the gold mines of the State will no doubt be able again to produce their average normal annual output of about \$20,000,000. One very good indication of this readjustment is that the Mother Lode mines, which produce most of the gold-bearing ore, though still making a smaller output than usual, are materially raising the average grade of the ore per ton. Moreover, some of these mines are finding in the lower levels a better grade of ore than was found in levels 1000 ft. or more above. The gold mine with the deepest vertical shaft in the State and in the United States is now extracting from the 4050-ft. level ore of much higher average grade than any other ore found for several years, a fact that is encouraging to all the gold miners in the Mother Lode counties and that is inducing them to sink deeper workings.

The labor conditions in the gold mines of the State, though still unfavorable, were improved somewhat in 1919 as compared with 1918—that is, more skilled labor was available or the mines were worked on more nearly full time. The employers complain, however, that labor is far more inefficient now than in normal times.

The principal cause of the reduction in the gold output of the State has been that steady continuous operation of the properties seemed impossible, owing to war conditions, scarcity of competent men, high costs, and curtailment of freight and power. Some mines were worked only a few months, others were worked with only one shift instead of three, and still others have been compelled to cease work entirely for long periods. Moreover, few of the large companies were willing to push production under the increased cost and to pay the resultant war tax. Many small mines that are owned and worked by only a few men still lie idle, or partly so, most of the

output being made by the larger mines. For three consecutive years mining in California has been handicapped by dry seasons, when water for washing gravel and for operating power was abnormally scarce. The large quantity of snow in the higher mountains at the end of 1919, however, gives promise of a better water season for 1920.

The cost of producing an ounce of gold at the mine has more than doubled during the last two years, and therefore, mines that had been working on a narrow margin of profit had to cease operations. Even the best of the deep mines now being worked are making only a small profit and some are making none at all; and the mines kept in operation have not been worked to their full capacity. Few new large mines have been opened during the year and prospecting for gold has nearly ceased, for it is now almost impossible to obtain capital for investment in gold mining. Only the richest and best mines in the State are now being operated; most of the others are lying idle awaiting more favorable conditions.

In this brief review no mention can be made of conditions or improvements at individual mines. A few dredging companies have worked out their ground and closed down, but the larger companies continue work as usual and have put into operation some large new dredges. The companies have suffered from lack of competent labor and from scarcity of hydro-electric power, both of which curtailed operations to some extent, but the output of gold from dredging has fallen off but slightly. Only in this branch of the gold-mining industry is there any sign that the reduction in the output of gold is due to the exhaustion of the deposits. Two of the older large dredging fields and a few smaller outside ones show some such signs, but the largest field is showing a material increase in production. The deposits worked by dredges, however, must necessarily show, from year to year, some exhaustion, the extent of which will depend on the capacity of the dredges working them. The larger deep gold mines, however, show no signs of exhaustion thus far, and few of them have been closed down for lack of ore, the reduction in their output having been due to other reasons entirely.

At present, 53% of the total gold produced in the State is being taken from the deep mines and 47% from the placers. The dredges are producing 95% of the placer gold and about 40% of the entire gold output of the State. The placer mines are from year to year gaining in output over the deep mines. Silicious ore from the deep quartz mines is yielding 95% of all deep-mine gold, and the dredges are producing exactly the same percentage of the total output of placer gold. The leading

*Preliminary report from the San Francisco office of the U. S. Geological Survey.

gold-producing county of the State, Yuba, is entirely a gravel-mining county, where more and larger dredges are operating than elsewhere. The gold output of this county is three-quarters of a million dollars more than that of the leading deep-mine county.

It is somewhat anomalous, though noteworthy, that the number of mines reporting production during the last two years shows a large increase. Nearly all the new productive mines, however, are small, producing from a few hundred dollars to a few thousand dollars worth of gold yearly. These mines have been opened and worked by men who, being without steady occupation or incapable of more profitable work, turned to nomadic prospecting and mining. Numerous mines that have been lying idle when assessment work was not compulsory and that had been left without caretakers have been gouged and gophered for small quantities of rich ore by these nomads. Much work has thus been done, not only in old shafts and tunnels but in small gulches and in the river beds and in banks along the rivers, creeks, and gulches, by 'crevicing' and by working small gravel bars here and there, some for the first and others for the second or third time.

SILVER. The output of silver from Californian mines in 1919 is estimated at 1,121,069 oz., valued at \$1,244,386, which is 306,642 oz. less in quantity and \$193,325 less in value than in 1918. The silver produced in California is derived mainly from copper and lead ores, although some is obtained with the gold mined at placers and in deep gold mines. The principal producers of silver in California are the Mammoth, Mountain, Balaklala, Shasta King, Afterthought, and Bully Hill copper mines in Shasta county; the Engels Copper Co., in Plumas county; the Penn Copper Co., in Calaveras county; the Blue Ledge, in Siskiyou county; the Island, in Trinity county; and the Ivanpah, in San Bernardino county. These are all copper mines. The lead mines that produce silver in large quantity are the Darwin, Santa Rosa, Cerro Gordo, Tecopa, and Slate Range mines in Inyo county. These mines together produced 1,007,335 oz. of silver in 1918 and only 345,272 oz. in 1919, so the decrease from these combined properties was 662,063 oz. of silver. The output of a new productive silver mine in 1919, that of Rand Divide Mining Co., in Inyo county, served to overcome to some extent the large deficiency shown by the mines mentioned above; but this output, though comparatively large, was not sufficient to make up entirely for the loss mentioned. Of the copper and lead mines named above, some were closed entirely in 1919, and the smelters in others were shut-down for the year in April and May. All were much less productive in 1919 than in 1918. Notwithstanding the high prices of silver during the year, comparatively few of the old and long-idle silver and lead mines in the southern part of the State became very productive, though a number have been and are being re-opened.

COPPER. The estimated mine output of copper in California in 1919 was 22,299,656 lb., valued at \$4,236,934, as compared with 47,674,660 lb., valued at \$11,775,641,

in 1918, a decrease in quantity of 25,375,004 lb., and in value of \$7,538,707. Plumas is the largest copper-producing county of the State, but Shasta, Calaveras, Siskiyou, and Trinity are also large producers, and small quantities are produced in most of the other metal-mining counties. The two largest copper smelters in the State, those of the Mammoth and Mountain Copper companies, of Shasta county, closed down in April and May, one because of labor troubles. The Balaklala mine, also in Shasta county, ceased operations in May also. Several other smaller mines also ceased or restricted their operations. Most of the smaller copper mines of the State stopped shipping ore almost entirely in 1919 because of the low prices for the metal and the high cost of operation, which together account for the large decrease in the copper output of the State in 1919 as compared with 1918.

LEAD. The mine output of lead in California in 1918 was 13,372,049 lb., valued at \$949,415, and the estimated output in 1919 was 4,455,161 lb., valued at \$253,944, a reduction in quantity of 8,916,888 lb., and in value of \$695,471. The output of lead in California was 8,496,579 lb. less in 1918 than in 1917, and the figures for 1919 show a decided and continued decrease. The lead is mined mainly in the southern counties of the State—Inyo and San Bernardino—where a number of the mines in the lead and zinc districts have ceased or curtailed operations owing to the high cost of labor and material, high shipping charges, and the low price of the metal. The Darwin mine, Inyo county, was closed entirely during the year and the Cerro Gordo was worked only a few months. Other large mines produced a smaller output for the year and many small properties in the counties named remained idle.

ZINC. The estimated output of zinc in the State in 1919 was 965,259 lb., valued at \$68,533, as compared with 5,561,393 lb., valued at \$506,087, in 1918, a decrease in quantity of 4,596,134 lb., and in value of \$437,554. Direct reports from the few zinc-producing companies of the State indicate an almost entire cessation of production at the larger plants. In Shasta county the Afterthought was idle throughout the year and the Mammoth most of the time; in Inyo county the Cerro Gordo was virtually idle, and the Western Metals Co. materially reduced its output.

THE TOTAL petroleum production in California during the year 1919 amounted to about 100,000,000 bbl., according to preliminary estimates by R. P. McLaughlin, of the California State Mining Bureau. The final figure will probably show that the year's output was slightly more than that of the year 1918. The total value of crude oil at the wells was about \$133,000,000, which is some five or six millions greater than the total value of the preceding year. Current statistics by private concerns disagree as to the actual amount of oil now stored, but do agree in indicating that stocks were somewhat less at the end of 1919 than at the beginning, which shows that the industry has not quite held its own.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

CALUMET & ARIZONA SHAFT-CONNECTION MADE.—'COMMUNITY WORK' AT GLOBE AND MIAMI.

The Arizona Section of the A. I. M. & M. E. recently held a well attended two-day field session at Ajo, where are centred the operations of the New Cornelia Copper Co. At the business meeting held January 5, President Winchell and Secretary Stoughton spoke at length on the aims and activities of the Institute. The coal situation, the establishment of a Bureau of Public Works, and increased co-operation among engineers were topics discussed. John C. Greenway gave a brief outline of the history of the New Cornelia property. F. Eckman, mine superintendent, described the method of blasting used at the mine, illustrating his subject by lantern slides. At the technical meeting held on the following day, the results of recent leaching experiments by the Inspiration Consolidated Copper Co., and the Arizona Copper Co., were presented. Recent leaching practice at Anaconda was also discussed. Five reels of moving pictures were shown, which illustrated the mine and plant operations at Ajo in every detail. The pictures illustrated particularly well two of the large blasts utilized in breaking the ore. It was estimated that 400,000 tons of ore was broken in the last and larger of the two. The meeting closed by a vote of thanks to the officials of the New Cornelia Copper Co. for the excellent program presented.

BISBEE.—The Campbell shaft of the Calumet & Arizona Mining Co. 'holed through', December 31. Every calculation in connection with the shaft worked out with mathematical nicety. Juncture of the shaft with the raise from the 1400-ft. level was made at 575 ft. The raise met the shaft exactly making a complete shaft almost 1400 ft. deep. This eventually will be used as one of the company's main hoisting-shafts. The new shaft is approximately 3300 ft. from the Briggs and 2700 ft. from the Junction. It is connected with the former by a cross-cut on the 1300-ft. level, and with the Junction on the 1400-ft. level. The underground surveys were carried out through these two shafts and checked by plumbing the raise. Work on the shaft was started August 15, 1919. Working two shifts daily an average of 125 ft. per month was made in sinking and 140 ft. per month in the raise. W. H. Holcomb and J. B. Fox were responsible for the underground surveys; A. J. Balmforth handled the surface survey, located by triangulation.

GLOBE-MIAMI.—During 1919, Old Dominion company mined and treated 267,450 tons of ore which produced

20,000,000 lb. of copper; 99,000 tons of custom ore was treated, yielding 8,500,000 lb. of copper. Besides the copper recovered the smelter report shows the recovery of 5000 oz. of gold and 127,000 oz. of silver. Between 3,600,000 and 7,000,000 gallons of water was pumped from the mine daily during the year. Although from 1000 to 1100 men were employed, there were no fatal accidents. There have been none, in fact, for 23 months. This splendid showing is attributed by the management to the lively interest taken by the men in safety and first-aid work. Since 'safety-first' week, last October, there has been a marked decrease in accidents, even those of trivial nature. No effort was made to attain heavy production, because of the condition of the copper market, but instead of laying-off its men the company transferred them to development. During the year the shaft was sunk from the 1800-ft. to the 2000-ft. level in spite of heavy water flow. The West winze was sunk from the 2000-ft. to the 2200-ft. level and the Kingdon shaft from the 1900-ft. to the 2100-ft. level. Very little construction was done during the year. A water-softening plant for the Diesel engine and a shaft boiler-plant were installed. Erection of a filtering-plant for the concentrator was started during the latter part of the year. Miami Copper had a very satisfactory year. Production last year amounted to 55,000,000 lb., operating at two-thirds capacity since March. Development totaled 14,509 ft. in drifts, raises, and shafts, while 1250 men were employed. A steel head-frame was constructed at No. 5 shaft, 125 ft. in height and containing 175 tons of steel. The concrete hoist-house is 90 by 61 ft. Two hoists have been installed, a man-hoist capable of raising 1200 lb. at the speed of 800 ft. per minute, driven by a 250-hp. motor. The other is a skip-hoist with rated capacity of 10 tons of ore per skip, operated by a 1400-hp. motor at 1500 ft. per minute. A new crusher plant, which will consist of two units, each capable of handling 200 tons of ore per hour, or 10,000 per day, is under construction. A new change-house, three stories high, which will contain 1470 lockers, with showers and toilet facilities, is under construction. The company has adopted the policy of erecting houses for employees. Fourteen bungalows were built during the year. Twenty-seven acres of war-gardens, divided into 230 tracts, on which crops valued at \$32,000 were raised last year, was a unique feature of outside activities of the company. A canning kitchen, operated in conjunction with the garden, was used by 190 persons. The total output of the kitchen was 2500 quarts of preserves, pickles, and jellies, valued

at \$1800. This effected a saving of \$2500 to the consumers. On November 1, the Miami commercial company's store was made co-operative and it was announced that every six months there would be a distribution of net profits to employees of more than three months service. Miami and Inspiration have opened a dispensary in Miami, conducted by the hospital force for the convenience of employees of the companies living in the town and adjacent valley. The International smelter produced 161,000,000 lb. of bullion during 1919, despite curtailment of production at Inspiration and Miami, upon which International depends for its supply of concentrate. Although operating at less than 70% capacity, Inspiration Consolidated was the largest producer of copper in Arizona. An interesting experiment during last year was the treatment of oxidized ores in a 30-ton experimental plant placed in operation last July. The experiment has been quite successful, it is reported, indicating that satisfactory recovery from oxidized and sulphide ores on a commercial scale will be possible. Superior & Boston experienced the most important year in its history. Following the change of management early in 1919, a definite program of development was adopted, the known ore-reserves having been almost exhausted. Attention was given to development not only of the Great Eastern vein, but to known and unknown veins lying between the Old Dominion and Great Eastern veins on the north, and the Black Oxide and Buckeye veins on the south. One of these cross-cuts has intercepted the Great Eastern on the 1200-ft. level but it has proved practically barren at this point.

ARKANSAS

OLD DAVIS MINE TO BE OPERATED BY B. & A. COMPANY.

Mining operations on one of the oldest veins in the South-West will be resumed shortly when the B. & A. Mining Co. of Okmulgee, Oklahoma, starts its new milling plant at the old Davis mine in the western part of Sevier county, 15 miles north of De Queen and six miles north-west of Gilham, Arkansas, the nearest railroad point. The B. & A. company took over the property more than two years ago and has already expended \$150,000 on the property, building a mill and putting in modern machinery. The right-of-way for a branch line 4 miles long from the railroad to the mine has also been purchased and surveyed.

The mine will produce zinc, lead, and copper ore. The width of the ore-zone varies up to 40 ft., containing sphalerite, chalcopyrite, and galena. The zinc is in shoots following the foot-wall and the copper and lead are disseminated through the zone. The main shaft has been sunk to a depth of 170 ft. and several drifts have exposed the orebodies. The mill at the mine is equipped with jigs and Wilfley tables, and the company is considering a flotation adjunct to handle the slime of the mill. C. L. Larson, formerly with the Bunker Hill & Sullivan company, of Idaho, is manager of the mine, Ernest W. Ellis is mill superintendent, and Joe J. Sanford is mine superintendent. The directors of the com-

pany are John W. Hammond, O. F. Dickenson, W. M. Hodsdon, F. P. Snider, Villiard Martin, Charles Popkin, W. J. Seekatz, N. Lambertson, and Milo Brown, all of Oklahoma.

The mineral vein at the B. & A. mine was discovered more than 40 years ago in an unusual manner. Levi Davis, of Gilham, while hunting near the present site of the mine shot a deer. While he was bleeding the deer, a horse which Davis had been riding struck a piece of rock with its hoof and the peculiar glint from the rock attracted the attention of the hunter. Davis took the rock home and later sent it to a mining man who declared that it was ore. Prospecting led to the discovery of the present large vein.

MICHIGAN

LAKE SUPERIOR COPPER OUTPUT.—FRANKLIN DEVELOPMENT.

HOUGHTON.—Neither the Calumet & Hecla nor any of its allied companies showed any increase in output in December. A number of difficulties combined to make the production smaller than in November. The Osceola Consolidated produced 55,420 tons of ore from all shafts in December. This is a decline of 4000 tons. The total output for the first 11 months of 1919 was 9,930,851 lb., so that the total for the year may reasonably be estimated at 10,730,000 lb. This means that the output of the Osceola Consolidated for 1919 was 50% below normal. In addition to the decline in the production the costs have been the highest in the history of the company and there has been no betterment in the quality of the ore. The South Kearsarge is about 'played out' and the richer territory to be tapped from No. 3 North Kearsarge has not as yet begun to show any appreciable effect on the total tonnage. The bulk of the ore comes from the North Kearsarge branch.

Ahmeek produced 59,802 tons in December. This is a drop of 10,000 tons from November. The 1919 output will total 16,907,000 lb. Ahmeek, given good market conditions and a fair labor market, can produce 30,000,000 lb. annually with costs as low as those of any mine in the district. Centennial produced 6660 tons in December, compared with 7000 in November. Centennial is one of the smaller allied companies of the Calumet & Hecla that suffers particularly from the difficulty that it is a property with ore on but one side of the shaft and with a comparatively limited number of openings in good territory.

Allouez is the only C. & H. company to make an advance in the last month of the year. The production of ore increased from 18,000 tons to 19,575. Allouez's output for the year 1919 may be estimated at 3,800,000 lb. Allouez is physically in shape to get back to a 10,000,000-lb. basis any time the metal market and the labor conditions warrant. Isle Royale output fell off in December, the total output being under 60,000 tons. The production from Isle Royale for 1919 will be 13,100,000 lb. Considering the conditions during the year this showing is remarkable. It means that Isle Royale comes nearer to normal than any of the other C. & H. properties.

Franklin's opening of the Pewabic amygdaloid from

the 39th level is in better ground than that opened above. When the Franklin was forced to suspend operations last fall the management wisely determined to continue openings in the Pewabic with the idea of carrying forward this work at comparatively slight expense and thus preparing for the future by getting as many advance openings ready as possible. The shaft was sunk below the 39th level, a cross-cut run over into the formation and from that point drifting on the vein started in both directions. Better progress has been made to the north than to the south. This is the same lode as opened in No. 1 shaft, that has furnished all of the copper ore sent

Lead ore was strong throughout the month selling at \$91 during the last week and averaging for the month, \$88.04. Production of lead ore also surpassed all previous records.

Throughout the year there has been a heavy stock of ores held in the bins of the producers as surplus stock. This has acted as a brake upon any advance in ore-prices. In addition from 20 to 50% of the producing plants were idle part of the year.

Tables showing the monthly shipments, value, and average price for zinc-blende and lead ore for the year of 1919 follow:



SURFACE PLANT AND MILL OF THE B. & A. MINING CO., NEAR GILHAM, ARKANSAS

to the mill by the Franklin mine in recent years. The Franklin has no plans for resumption of general mining and milling operations until the market promises 22c. per pound.

MISSOURI

PRODUCTION DURING 1919.

All records for ore-production were again broken in the district during 1919 in spite of the fact that the year's average prices have receded to the lowest level prevailing for a period of five years. The total of zinc-blende ore mined was 435,392 tons, and calamine 12,445 tons. This is an increase of 60,415 tons over the record of 1918 for blende ores, but calamine showed a decrease of 2200 tons from the record of 1918. There was a time when calamine ore-output had a ratio of one to ten with blende but the production is gradually becoming almost negligible.

The last month of the year showed a price of \$50 to \$52.50 for zinc-blende ore while calamine sold generally at \$35. The average for the month was \$49.21 for blende ore and \$34.43 for calamine ore. Shipments for the month aggregated 31,322 tons of blende ore and 382 tons of calamine.

	Zinc-Blende		
	Tons	Value	Average price
January	26,636	\$1,157,417	\$43.45
February	34,429	1,047,458	41.78
March	48,972	2,034,621	41.55
April	34,922	1,357,633	38.87
May	46,278	1,749,603	37.80
June	34,001	1,437,623	42.28
July	32,668	1,706,689	52.24
August	34,148	1,872,958	49.00
September	22,832	984,305	43.11
October	35,346	1,568,473	44.37
November	48,838	2,239,247	45.85
December	31,322	1,541,494	49.21
Year	435,392	\$18,997,521	\$43.63

Surplus stock at end of year 32,000 tons unsold, and 28,000 tons sold but not yet shipped.

	Lead Ore		
	Tons	Value	Average price
January	6,908	\$114,650	\$60.04
February	5,015	260,577	51.95
March	7,187	442,463	61.56
April	5,545	322,250	58.11
May	7,895	451,217	57.15
June	4,765	282,692	59.32
July	4,335	279,129	64.39
August	6,150	394,535	64.15
September	5,105	362,498	71.00
October	5,085	452,859	79.66
November	8,110	699,079	86.19
December	6,372	560,992	88.04
Year	73,070	\$4,922,961	\$67.37

Surplus stocks end of year 200 tons as against 150 tons in 1918.

NEVADA

FAVORABLE OUTLOOK AT EUREKA.—FLORENCE-GOLDFIELD
ASSIGNS LEASING GROUND.

EUREKA.—In a report on the Croesus made for Sir Donald Mann, known for his connection with the Canadian Northern railway and interested in the Croesus and Eureka King mines, Ralph W. Foster, his engineer, estimates that there is 2,368,635 tons of ore and slag of a net value of \$59,271,990 available for treatment by the Croesus company. He puts a value of \$1,600,000 on the slag dump at the old smelter, which he estimates to contain 40,000 tons. The report is based on ore exposed by the work in recent years through the Catlin shaft and in surface dumps, and does not include material used as filling for stopes in the early days. The gross value of the ore in the mine and surface dumps, and the slag pile, a total of 2,368,635 tons, is placed at \$73,483,800, with the cost of mining and treatment estimated at \$6 per ton, or a total for mining and treatment of \$14,211,000. The engineer points to the possibilities in work at greater depth and to the increase in the value of the ore as depth is gained, as shown by lateral work on the 400-ft. level and in the 300-ft. winze from that level.

TONOPAH.—The Tonopah Extension has announced that sinking of the McKane shaft will be resumed and connection made with the 1540-ft. level of the Victor shaft. This will be done in an attempt to open the Murray and other veins far west of where they have been developed.

MINA.—The 100-ton cyanide mill of the Olympic Mines Co., which was destroyed by fire on November 21, is to be re-built in the spring. The plant, built in 1916 at a cost of \$75,000, was insured for \$60,000. Development of the mine has continued since the mill was destroyed, the principal work being further exploration of a vein paralleling the main ore-channel which was opened shortly before the fire. The Olympic mine is at Omco, 25 miles from Mina in Mineral county. The Drew-Bugg mercury mine, owned by the Mina Quicksilver Co., has been taken over by H. G. Torrance of Oakland, California, a first payment of \$10,000 having been made on the purchase price of \$75,000. The mine has produced over \$200,000 to a depth of less than 200 ft. The equipment for reduction of the ore consists of two D-type retorts and 12 Joshua Hendy pipe furnaces. The ore is found in fissures in limestone and it contains in addition to the mercury, silver, lead, and gold, the value in the four metals making a high-grade product from which only the mercury is extracted. The dump at the treatment plant is estimated to be worth \$200,000. In recent months the output has been from 100 to 150 flasks.

DIVIDE.—Small seams of ore giving high assay returns have been found on the surface of the Keller lease on the Beats All claim of the Pay, adjoining the Belcher Extension on the south. The Treasure lease on the Polo claim of the Revert is reported to have opened two feet of ore assaying over \$200 in silver and gold in the bottom of a 45-ft. shaft. The south drift on the 200-ft. level of the

Caldwell shaft of the Divide Extension is 40 ft. long and high assays continue to be secured, according to unofficial reports. Work on the 45 and 100-ft. levels of this shaft continues to expose ore of good grade, with a drift on the latter level in ore for 100 ft. A contract has been let for extending the north drift on the 425-ft. level of the main shaft to cut the downward extension of the Caldwell ore-shoot. Prospecting of the outcrop of the main vein of the district continues in the Thomson, but a favorable site for sinking a shaft has not been found.

GOLD MOUNTAIN.—Because of slow progress in hard lime on the hanging wall of the vein a cross-cut has been driven to the foot-wall from the 100-ft. point in the drift-tunnel of the Washington Gold Quartz. The tunnel will be continued in porphyry lying on the foot-wall. Assays of from \$30 to \$40 were secured at many places in the lime, but the first objective, a cross vein, has not been reached. The vein is from 40 to 45 ft. wide.

GOLDFIELD.—The Florence leases for this year have been signed, the principal blocks being given to the Florence Divide, Cracker Jack, and Red Hill in the north-western part of the Red King claim. The Florence Divide secured a block covering the stope from which rich ore was mined last year, and territory north and west from the stope and extending from the surface to the 530-ft. level. The stope extends 60 ft. above the 380-ft. level. In addition to this the Florence Divide was granted a large block from the 530-ft. to the 650-ft. level containing the vein on the dip. The Cracker Jack was given what is considered the most valuable lease, extending from the surface to from 430 to 530 ft. and far into the practically undeveloped hanging wall of the vein from the Florence Divide stope. The Red Hill has the ground under the Cracker Jack block to a depth of 650 ft. There is little ore of shipping grade exposed in this part of the mine, the Florence Divide having stopped development work to extract all ore available in the closing days of the lease, but the entire territory held by the three companies is regarded as having exceptional possibilities. An unusual feature of the work started by the Cracker Jack is that an ore-shoot is being followed from the surface with a shaft. Surface prospecting with trenches also is being done by this company. Repairs to the shaft of the Great Bend have been completed, including re-timbering from the 300 to the 400-ft. level, and the east drift on the 375-ft. level is now being put in shape for resuming work near the face. The Development company has shipped 40 tons of ore from the rich shoot recently found in the Combination. No estimate of the value has been made.

ELY.—The Consolidated Copper Mines Co. at Kimberly, is working a small force, sinking the five-compartment shaft (known as the Giroux) below the 1400-ft. level to reach the sulphide zone. The water is caught on the 1200-ft. and 1400-ft. levels so the bottom of the shaft is comparatively dry and good progress is being made below the 1600-ft. level. The shaft is entirely in limestone thus far, but in the neighborhood of 1900 ft. it is expected that the mineralized zone will be penetrated.

The Nevada Consolidated Copper Co. is running six of

the eight sections of the concentrator at McGill. Repair men are overhauling one section of the mill, taking out the rolls and elevators, and installing a Hardinge mill, with Dorr classifiers, oil flotation, and Wulley tables. It is probable that the entire mill will be changed along these lines.

UTAH

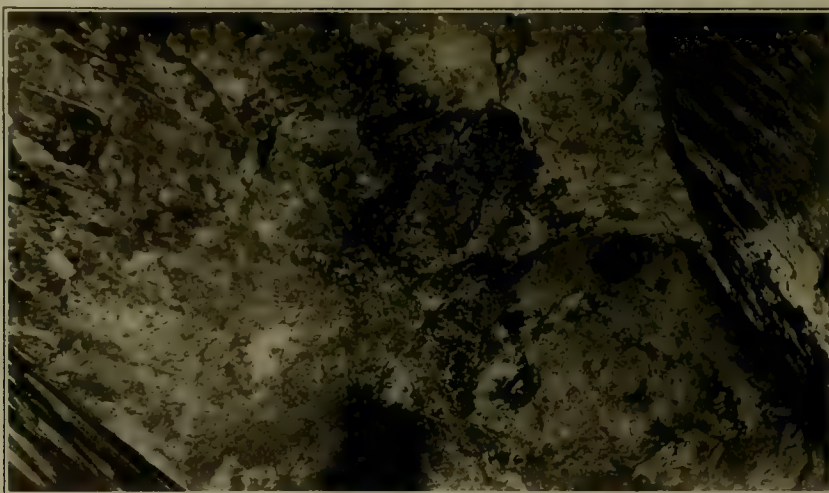
DIVIDENDS DURING 1919.—TINTIC PRODUCTION.

SALT LAKE CITY.—During 1919, the metal mines of Utah distributed to their stockholders a total of \$11,225,801 in dividends. The companies making such disbursements, together with the amounts, are as follows:

Bingham Mines Co.....	\$112,500
Cardiff Mining Co.....	75,000
Chief Consolidated Mining Co.....	282,950
Daly Mining Co.....	97,500

the early seventies with much success. Three cars shipped in the early days averaged 900 oz. silver, 40% lead, and 3% copper, while it is stated that during one season Mr. Wagener realized \$90,000 from the property. Most of the work done was comparatively close to the surface, leaving the Cardiff overthrust contact practically untouched. The new owners have been pushing work along the contact and are said now to have very promising indications, which, it is believed, will develop into a good body of ore. Fred W. Price, manager of the Price mine in this district, states that the company recently opened up a 15-ft. vein at a distance of 750 ft. from the tunnel portal.

EUREKA.—Officials of the Eureka Lily company state that the ore showing in the south drift on the 1600-ft. level is steadily improving. The vein is two feet wide at the point just reached. This orebody averages 7% cop-



ARROWHEAD VEIN. SIX FEET BETWEEN WALLS. 100-FT. LEVEL, ARROWHEAD MINE, NYE COUNTY, NEVADA.

Eagle & Blue Bell Mining Co.....	89,314
Grand Central Mining Co.....	36,000
Iron Blossom Mining Co.....	50,000
Judge Mining & Smelting Co.....	60,000
Ontario Silver Mining Co.....	75,000
Sacramento Mining Co.....	9,000
South Hecla Mining Co.....	39,450
Tintic Standard Mining Co.....	552,109
Utah Copper Co.....	9,746,940
	<hr/>
	\$11,225,763

During 1918, the total amount of dividends paid by the metal mines of the State was \$19,511,745, while in 1917—the banner year for such disbursements—the total was \$29,339,451. The grand total of dividends to the close of 1919 is \$212,851,759.

ALTA.—According to R. O. Dobbs, manager of the Louise Mining Co., purchase by his company of the Moltke claims in this district was completed recently when the final instalment of \$40,000 was paid. The property, which consists of six patented claims, was originally owned by Henry Wagener and was worked in

per, 11 oz. silver, and \$4.60 in gold. Development of this promising vein will be pushed, and at the same time, sinking on the main shaft, which is now 150 ft. below the 1600-ft. level, will be continued. The estimated production from this district during 1919 is 265,000 tons, exclusive of iron ore, as compared with 362,494 tons in 1918. Preliminary figures indicate an output of 25,000 oz. gold, 6,800,000 oz. silver, 2,800,000 lb. copper, and 24,000,000 lb. lead for the past year. The mines that produced more than 1000 tons during the year are the Dragon, Chief Consolidated, Iron Blossom, Eagle & Blue Bell, Tintic Standard, Centennial-Eureka, Grand Central, Swansea, Mammoth, Colorado, Ridge & Valley, Empire, Bullion Beck, Gemini, and Victoria. After a brief holiday, all of the mines are again operating on a normal basis. Labor conditions are good and local operators look forward with a great deal of optimism to metal-market conditions during the coming year.

Directors of the Chief Consolidated have declared a dividend of 10c. per share, payable on February 2. Dur-

ing 1919, the company paid four dividends; the first being 12½c. per share and the other three 6½c. per share. While this property is the largest producer of silver in Utah and one of the largest in the United States, construction expenditures last year were very heavy, which accounts for the moderate rate of dividend disbursements. One of the largest and most expensive pieces of work undertaken last year is still in progress. This is the sinking and concreting of No. 2 shaft, which is now down 950 ft. and within a short time will be down to the 1000-ft. level, on which level a connecting drift has already been driven from the main workings.

The Jesse Knight interests of Provo have added to their holdings by the acquisition of the Tintic Central property. The Knight people have for some time been heavy stockholders in this property, and quite recently they secured enough stock to give them control. The holdings of the Tintic Central adjoins those of the Iron Blossom, through which the development of the former has been carried on during the past year. In recent years the Tintic Central has been carefully developed, first through its own shaft, down to a depth of 1075 ft., and later through the Iron Blossom.

The south shaft of the Tintic Standard mine, being sunk under contract, has reached a depth of 1200 ft. and sinking will continue. One of the most important pieces of work outlined for the present year at this property is the development of the south end, which will incidentally bring about a better ventilation of the entire mine.

PARK CITY.—During the past week announcement was made by O. N. Friendly, superintendent of the Judge Mining & Milling Co. that the Judge smelter, which has been closed since May 1919 will resume operations about the middle of January, under the direct management of John Ellsworth. Work will soon be commenced on the erection of new Dorr thickeners and filter-presses for an additional treatment of the lead-silver residues, which will also result in increased recovery of zinc. The Judge smelter handles zinc-lead ores from local mines exclusively.

WISCONSIN

DECEMBER OPERATIONS IN ZINC DISTRICTS.—OUTPUT OF LEAD, ZINC, AND PYRITE DURING 1919.

PLATTEVILLE.—The month of December brought added distress to mine operators of the Wisconsin zinc region. An acute shortage of coal compelled the Inter-State Power Co., which supplies power and light to all the mining districts, to enter into an arrangement with mine operators whereby operations in all departments were to be conducted four days a week. On the remaining three days, pumps alone were to run. Such a program necessarily imposed considerable financial loss on operators as well as the power company and discussion for a time favored a complete shut-down. This was regarded as a disastrous procedure since it carried with it the scattering of mining forces and the loss of experienced miners, of whom there are at the present time not less than 2000. Prices for zinc ore were good all month and a fair show-

ing was made in spite of difficulties, not the least of which was a period of frigid weather unlike anything experienced in many years. The thermometer ranged from 20 to 30° below zero. Especial effort was required to keep reservoirs and intakes open at mills and keep pipe connections from freezing. More coal than ordinarily required became imperative to keep ore-bins, change quarters, and offices comfortably heated. Top grades of zinc ore reached \$54.50 per ton, base, the second week of the month, which brought the premium price paid to \$56. The remainder of the month found quotations from local exchanges unavailable.

The zinc ore milled during December amounted to 11,015 tons; net deliveries to smelters, including mine-run to smelters direct, 6982 tons. The Frontier Mining Co. disposed of 2500 tons of fair-grade concentrate to the Mineral Point Zinc Co., all of which was surplus stock, thereby reducing the reserve in the field to this extent. It is believed that other stock-piles long held unsold, will come in for similar treatment early in the new year.

Producers of lead ore met with better satisfaction in the markets, the price of high-grade lead concentrate opening the month at a point in advance of \$82 per ton. The price advanced to \$85 per ton, about the middle of the month and the last week of the month found offerings of \$90 per ton, with top going at \$92 per ton, and some competition developing between the leading buying concerns. The reserve in the field, at all points, conservatively estimated, exceeded 1500 tons, at the close of the month.

Producers of zinc-carbonate ore met indifferent offers during the month, the price running from \$27.50 to \$30 per ton, base, 40% zinc, but the closing days of the month witnessed a spurt and the price reached high at \$35. Independent operators, however, had withdrawn from the market and shipments did not show the volume expected for the month.

Offerings for iron-pyrite, the bulk of which has been coming from ore-refineries, have been of an unsatisfactory nature for a long time and shipments have dwindled for several months. The reserve closely estimated indicates that there is not less than 10,000 tons of unsold pyrite at separating-plants, alone.

Shipments of zinc ore, lead ore, and pyrite, by districts, for 1919 were made as here shown:

Districts	Zinc tons	Lead tons	Pyrite tons
Benton	83,050	2,489	10,247
Galena	24,806	1,997	.....
Livingston	21,096	309	73
Hazel Green	9,959	40	.....
Shullsburg	8,001	473	.....
Highland	8,045	275	.....
Cuba City	6,964	1,404	4,975
Platteville	3,312	.....	.....
Linden	865	19	.....
Dodgeville	190	30	.....
Mineral Point .....	.....	.....	2,500
Total	168,088	7,036	17,795

The total net deliveries out of the field for the year to smelters comprise 100,703 tons zinc ore, 7036 tons lead ore, and 17,795 tons pyrite. The total production of lead ore is placed at 8600 tons; pyrite, 28,000 tons.

Deliveries of high-grade blende, from electro-magnetic separating plants, were made by the leading refiners: the Mineral Point Zinc Co., 29,097 tons; Wisconsin Zinc Co., 24,636 tons; National Zinc Ore Separating Co., 21,428 tons; Oliver Mining Co., 1930 tons; Linden Zinc Co., 3276 tons; Block-House Mining Co., 1763 tons; total, 53,130 tons. The average price paid for the year, per ton of ore, all grades was \$44.38.

Expansion of the industry is planned at all points, and a score of new power, mining, and milling plants will be



LOOKING DOWN NEW CONCRETE SHAFT 750 FT. DEEP,
CHIEF CONSOLIDATED MINE AT EUREKA, UTAH

erected within the next six months. Drills are operating extensively in the Benton, Shullsburg, Cuba City, and Platteville districts. Exceptionally rich strikes have been made at several points by the Wisconsin Zinc Co., Zinc Hill Mining Co., New Jersey Zinc Co., and the Vinegar Hill Zinc Co.

Wages are high at all mines, good shovelers earning from \$6 to \$8 per shift. Men are in demand in all the active mining camps.

BRITISH COLUMBIA

PHOENIX MAY BE REHABILITATED.—PROSPECTORS' ASSOCIATION.

TRAIL.—Nineteen Kootenay properties exported ore or concentrates for treatment in various American smelters. These exports were nearly all concentrates, although 3143 tons of high-grade ore was shipped, which at \$100 per ton would be valued at \$314,300. The concentrate amounted to 13,260 tons, which at \$250 per ton would total \$335,000. The total exports for the Kootenay-Boundary district are valued at \$649,300.

Referring to ore and concentrate the production of the district for 1919, inclusive of a few outside shippers, follows:

	Mines	Tons ore	Tons concentrate
To Trail smelter.....	134	302,589	10,072
To Granby smelter.....	3	156,821	.....
To American smelters.....	19	3,143	13,260
Total	156	462,553	23,332

GRAND FORKS.—Since the closing down of the Phoenix mines of the Granby Consolidated, with the result that the formerly busy town of Phoenix now is deserted, there have been reports that the company has plans which will rehabilitate Phoenix to some extent. The assertion now made is that the company proposes the installation of a concentrating plant at or near Phoenix for the handling of the low-grade ores of the mines. The volume of water necessary is said to be available. Such action, it is pointed out, might lead to the resumption of smelting at the Grand Forks smelter.

NELSON.—The British Columbia Prospectors' Protective Association has been organized with a membership of 85, with headquarters at Nelson. The officers are J. W. Mulholland, president; C. E. Crossley, vice-president; Fred A. Starkey, secretary; and Dr. R. E. Morrison, treasurer. The objects of the organization as outlined are: to deal with the matter of grants from the Government for roads and trails to mining properties; to continue the agitation for a Government ore-testing plant in the Kootenay district; to advocate the re-opening of dormant crown-granted mineral claims; to secure free sets of surface samples for purposes of study by prospectors; and to take the necessary action to have prospects examined by the district engineer, or by an engineer representing the association.

SANDON.—The Soho mine, which adjoins the Rambler Cariboo, in the Slocan district, has been re-opened after 18 months of idleness. There are four veins on the property, the two principal being the Tom Moore, upon which over 3000 ft. of development has been done, and the Soho, on which are a 100-ft. shaft and two drifts. Two cars of ore was taken out during the sinking of the shaft. Some \$60,000 worth of high-grade has been taken from the property, and there is a dump of milling ore, having an estimated value of \$10,000. Eight inches of high-grade sulphide, unusually rich in silver, has been struck at the Ottawa mine, which is being worked by Pat Maguire and A. L. McPhee on a lease from the Consolidated M. & S. Company.

STEWART.—The first shipment of ore under the new ownership has been sent from the Premier mine to the Tacoma smelter aboard the 'Prince Albert'. The shipment consisted of 225 tons, having an estimated value of \$450 per ton, the total value amounting to more than the Neill syndicate paid for the property.

MERRITT.—On the last Saturday in the old year the miners of this district organized a union, to be known as the Nicola Valley Mine Workers' Association. David Coupland is president and James Gaeter is secretary-treasurer.

AINSWORTH.—The Florence mine, Princess creek, has resumed operations, after a shut-down made necessary by the recent cold weather. The intensity of the cold may be judged from the fact that running water in a pipe two feet in diameter froze solid. A new body of milling ore, eight feet wide, has been found in the No. 5 tunnel.

ONTARIO

METAL OUTPUT OF CANADA DURING 1919.—LABOR CONTROVERSY AT COBALT.

A statement by John McLeish, of the Division of Mineral Resources and Statistics, Ottawa, estimates the value of the total mineral production of Canada during 1919 at approximately \$167,000,000, as compared with \$211,301,897 in 1918. During the past four years the mineral production increased from \$128,863,075 in 1914 to the high-record figures of 1918, under the stimulus created by the War demand. With the close of hostilities came an almost immediate cessation of the demand for nickel, copper, lead, and zinc, with large stocks on hand. The result was a considerable falling off in production, especially in nickel, the output of which dropped from 92,507,293 lb. in 1918 to 43,000,000 lb., and copper, of which 118,769,434 lb. was produced in 1918 as against 81,500,000 lb. last year. Gold and zinc are the only metals showing an increase, the value of the gold output being estimated at \$16,275,000, as against \$14,463,689 in 1918. The output of silver dropped in volume from 21,283,979 oz. to 13,500,000 oz., but the decrease in quantity will be to a large extent counter-balanced by the increase in price. Coal production amounted to 12,500,000 tons, as compared with 14,997,926 tons in 1918.

PORCUPINE.—The Hollinger Consolidated had a record output for 1919. The total production is unofficially estimated as approximately \$7,000,000, this estimate being based on official reports covering the first 36 weeks of the year. The output for 1918 was valued at \$5,752,370. The aggregate production since the mill began operating in 1911 amounts to \$32,430,753, and the dividend disbursements to \$11,146,000. The company is now treating between 2700 and 2800 tons of ore per day. Among recent improvements undertaken in order to reduce operating costs is the change in the main haulage from the 425-ft. to the 500-ft. level, which will centralize the work.

GOWANDA.—A complete mining plant has been installed at the Silverado, where excellent progress in development has been made. The shaft is down 60 ft., at which depth five calcite veins are in evidence. At the Kells claims, recently secured by Governor Smith of Vermont and associates, a steam plant is being put in. Considerable high-grade ore is in sight. It is expected that shipments of ore will be made from the Walsh claims in about a month. The Camburn has proved a disappointment. Work has been discontinued and the plant removed.

COBALT.—The McKinley-Darragh has issued a financial statement as of December 15, in which a surplus of \$493,995 is shown. This equals two year's dividend requirements at the current rate of 3% quarterly. In addition, the present output is resulting in profits adequate to meet dividend requirements as well as adding a small amount to the surplus. The Northern Customs concentrator has made a second payment on the purchase of the Chambers-Ferland. The purchase price is \$155,000. Of this, \$50,000 has been paid. The Cobalt Miners' Union has voted in favor of breaking away from the In-

ternational union. At present considerable controversy centres about the question of a future course or policy.

SONORA

TROOPS RESTORE ORDER IN CANANEA.

DOS CABEZOS.—The lessees of the Dos Cabezas mine, Alfred Paul, Millard Haymore, and Frank Whalen, are making regular shipments of concentrate by way of Douglas to the El Paso smelter, packing 132 miles from the mine, which is on the western slope of the Sierra Madre range. The old mill on the property has been rebuilt to combine flotation and water concentration. Excellent recovery is being made. Thirty men are employed by the lessees in mine and mill. Mr. Whalen has active charge of the property. Dos Cabezas is the property of the Pearson Syndicate, a British corporation operating mines and lumber mills in the State of Chihuahua. It has been worked for many years and has large bodies of silver-lead-gold ore developed. The main shaft is 500 ft. deep with several thousand feet of drifts and cross-cuts underground.

CON. VIRGINIA.—Roy R. Belknap and John Cleveland have reached here from Bisbee to take charge of mining and development work for L. C. Shattuck, of Bisbee, who recently bonded the Con. Virginia from Ygnacio Soto of Douglas. A force of 20 men will be employed at first. Mr. Soto accompanied Messrs. Belknap and Cleveland as far south as Moctezuma in order to have necessary legal details attended to before they took possession of the mine. Con. Virginia is a gold-silver prospect on which only shallow workings exist at the present time, but for which a great future is predicted by those in a position to know.

CANANEA.—The arrival of troops and the issuance of an injunction against the municipal government by the Federal Judge at Nogales, Sonora, to restrain it from putting into effect the order issued last fall that all Chinese merchants must go out of business here with the close of 1919, has returned Cananea to normal conditions once more. The Chinese are doing business as usual and public sentiment against them appears to have died down considerably. A message from Governor Adolfo de la Huerta of Sonora, to Julian S. Gonzales, presidente municipal of Cananea, requested that the people be patient and await action of the Federal Congress before which a resolution cancelling the treaty with China is pending. The effects of the anti-Chinese campaign in Cananea are in evidence in every mining camp of the State where the Celestials occupy the position of principal merchants, restaurant keepers, and leaders in other lines having direct bearing on the cost of living. Mistreatment of Chinese is reported to be common. Although forced to pay higher taxes than natives they manage to undersell them as a general thing, and as a result the Chinese receive the bulk of the native trade. The Cananea Consolidated Copper Co. now is employing only 3100 men. In order to relieve distress among men thrown out of employment by this reduction, the municipality of Cananea is doing a considerable amount of street repairing.



PRODUCTION OF GOLD AND SILVER IN THE UNITED STATES IN 1919

The Bureau of the Mint and the Geological Survey have issued the following preliminary estimate of the production of gold and silver in the United States during the calendar year 1919.

State or Territory	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value*
Alaska	437,131	\$9,036,300	1,072,137	\$1,301,705
Arizona	202,038	4,176,500	4,298,769	4,816,033
California	840,758	17,380,000	1,204,004	1,349,508
Colorado	470,998	9,736,400	6,044,911	6,775,438
Georgia	48	1,000	10	11
Idaho	34,365	710,400	6,042,016	6,772,194
Illinois			2,393	2,682
Maine	6	100	4,142	4,843
Michigan			375,284	420,637
Missouri	5	100	59,460	66,646
Montana	119,085	2,461,700	14,940,527	16,746,090
Nevada	230,004	4,754,600	7,312,454	8,196,164
New Hampshire			659	739
New Mexico	28,817	595,700	712,791	798,932
North Carolina	48	1,000	49	55
Oregon	51,848	1,071,800	223,578	250,597
Philippine Islands	39,962	826,100	14,392	16,131
Pennsylvania			78	87
South Carolina	5	100	4	4
South Dakota	254,820	5,267,600	122,164	136,928
Tennessee	256	5,300	93,087	104,337
Texas	53	1,100	540,239	605,527
Utah	104,137	2,152,700	11,906,152	13,345,010
Vermont	10	200	1,819	2,039
Virginia			8	9
Washington	14,987	309,800	316,028	354,220
Wyoming	15	300	41	46
	2,829,395	\$58,488,800	55,285,196	\$61,966,412

*Valued at the average New York price of fine silver, \$1.2085 per ounce.

These figures, compared with those for 1918, show a reduction in the output of gold of \$10,157,900 and in that of silver of 12,524,943 ounces; compared with those for 1917, they show a reduction in gold of \$25,261,900, and in silver of 16,455,166 ounces.

ARIZONA

Chiricahua.—The Hill Tops Metals & Mining Co., of Chiricahua, Arizona, is considering the building of a reduction plant at its mines and the construction of a railroad from its property to San Simon.

Kingman.—The new shaft in the Green Quartz Mining Co.'s vein has reached a depth of about 35 ft. and is in four feet of ore running about \$15 per ton in gold.

Phoenix.—Development at the United Arizona Copper Mining & Smelting Co.'s property, situated 35 miles northeast of Phoenix which has been delayed by washouts, is to be resumed upon the completion of repairs to the road and bridge. A double-compartment shaft is being sunk and is now down 875 feet.

Prescott.—The Silver Cycle Mining Co., of Prescott, Arizona, will build a mill and small smelter, and install an aerial tram at its Dunkirk mine, situated in the Senator district, south of Prescott, according to O. O. Smith, superintendent.

Ray.—It is announced that the Arizona Hercules Copper Co. has temporarily suspended operations. In the meantime there are to be some changes in the mining and milling methods. The company has announced that upon the resumption of operations the wages of miners will be according to the sliding-scale which at the present price of copper

would yield a bonus of less than \$1.70 per shift which the company has been paying. About 300 men were affected by the shut-down.

CALIFORNIA

Alleghany.—Work has been resumed at the Tightner mine under the management of A. Hall. It is reported that the orebody has been recovered.—Preparations are being made for more extensive work by the Mariposa, El Dorado, and several other local companies.

Portola.—The Walker Mining Co. has arranged to increase the capacity of its flotation plant to 200 tons per day, and to build an aerial tramway from the mine to Spring Garden, eight miles distant. The tramway will eliminate the costly 25-mile haul to Portola. The main orebody is said to have been proved for a distance of 800 ft. by drifting, and for an additional 900 ft. by diamond-drilling. It has an average width of 16 ft., according to late reports.

COLORADO

Mayday.—Wynn and Marr have secured a contract from the Lewis Mountain M. & M. Co., and will extend the Ten Broeck tunnel 200 ft. farther on the vein. This tunnel is 3000 ft. long and was driven to cross-cut the vein at depth. The vein is said to be 2 ft. wide, assaying \$70 to \$126 per ton.

Ouray.—Luna and Eckman are getting out ore from the Wedge.

Silverton.—The snow on the ground is so deep that many prospects have been abandoned for the winter. Aside from the Southwestern company's operations on the Iowa Tiger, there is little production at the present time.—Dora Consolidated M. & M. Co., Anvil Leasing Co., and Reid leases on the Champion ship an occasional car of ore.—The Little Nation Mining Co. is now operating on the Royal Charter getting out a large tonnage of ore.—The Gold King Extension Mines Co. has opened the road to Gladstone, and is running the mill.

Telluride.—Production from the district is at a low ebb. The Tomboy Gold Mines Co. had a breakdown shortly after starting up the new mill, with the result that there was no production for a period of two weeks, but the mill is now running steadily.—The Smuggler Union Mining Co. has purchased a saw-mill near Rico.

IDAHO

Coeur d'Alene.—Frank M. Smith, assistant director of the Bunker Hill & Sullivan smelter, has been in the Coeur d'Alene district acquainting himself with ore production of the district. The Bunker Hill smelter has launched out into the custom smelting business and is looking for custom ores to treat at its Kellogg plant.

A consolidation of the stock interests and holdings of the Black Bear Mining Co. and the Flynn group in the Coeur d'Alene is being negotiated. A consideration of \$250,000 is said to be involved.

Gem County.—The Zulu silver mine at Pearl, under development by Walter H. Hill of Boise since last April, has shipped some ore to Utah smelters. An operating company has now been incorporated under the name of the Zulu-Pearl Mining Co. and arrangements have been made for the build-

ing of a 50-ton mill. Some high-grade silver ore, running up to 600 oz. silver, has been opened in this mine during the last few months, according to Mr. Hill.

MONTANA

Butte.—The Otesco and Heany shafts, being equipped by the Butte & Superior are about ready to start operations.

The Anaconda company is building a Bradley fertilizer plant at Anaconda to utilize sulphuric acid manufactured at the smelter and phosphate rock shipped from Idaho, to make super-phosphate.

The bond issue of the Tuolumne Copper Co. has been authorized at the stockholders' meeting in Phoenix, Arizona. The bonds amount to \$50,000 convertible into stock at \$2 per share and bear 7% interest.

The Butte-Elk Park Extension Mining Co., which is developing a group of claims one mile from Elk Park station on the Great Northern railroad, is re-timbering the 120-ft. shaft. The old 6 by 6-in. hewed-timber put in when the locators sank the shaft, is being replaced with 10 by 10-in. Oregon fir. As soon as a coal supply is assured the sinking of the shaft will be resumed. The shaft is 400 ft. deep at present and is to be sunk 800 to 1000 ft. deeper and the ground explored at depth.

Hickey Brothers, pioneers of Butte, are to resume the development of the Honolulu claim in the extreme eastern section of the district. They are driving a tunnel to cross-cut the vein and then they purpose to drift east.

Pat Keeney and associates have sunk the shaft on the Syndicate lode to the 150-ft. level and are cross-cutting north and south to the veins that traverse the ground. This claim is south and east of the Davis-Daly and west of the Anaconda company's Belmont mine.

The Great Butte company has suspended operations and sold all supplies and equipments. This concern was developing a group of claims about three miles north and east of Butte. They sank a shaft 2000 ft. and did extensive drifting, but did not develop any workable orebodies.

NEVADA

Gold Circle.—On the 300-ft. level of Missing Link claim of Big Chief Consolidated a shoot of \$200 ore is under development. The shaft is to be sunk to 400 ft. following the placing of new pumping equipment. Sinking is in progress from the 260-ft. level of General Grant claim on a vein 9 to 11 ft. wide.

Mina.—H. G. Torrance, of Oakland, California, has purchased the Drew-Bugg cinnabar property 12 miles east of Mina. The purchase price is said to be \$75,000, with \$10,000 as the first payment. In addition to quicksilver the ore carries gold and silver. It is the plan of the new owner to immediately install a 50-ton flotation plant. Later on a furnace for reduction of the cinnabar is planned.

Sunshine.—J. B. Ratliff and associates are preparing a shipment of silver-gold ore from a lease on the Gem Five. The ore is said to assay \$100 to \$500 per ton with silver predominating.

WASHINGTON

Colville.—A mountain top consisting of 30,000 tons of dolomite was blown up at noon on New Year's day at the dolomite quarries east of Colville. For two months the Tulare Mining Company has been preparing for this explosion. At 12:30 o'clock New Year's day the mountain top was 'dislocated' by the discharge of 7150 lb. of 10% giant-powder set off by firing 100 lb. of 40% powder. The explosion was divided into two charges placed 26 ft. apart in the mountain cliff, which was entered by a tunnel 41 ft. long, 3½ ft. wide, and 5 ft. high. After the charges were placed the tunnel was completely blocked and the powder was exploded with a blasting-battery and electric caps.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Howard D. Smith has returned from New York.

Oscar H. Hershey is spending this week at Kellogg, Idaho.

Oscar Lachmund is at St. Louis, on his way to New York.

H. D. Quimby has gone to Spokane, on his way to New York.

Edwin O. Holter and **Harold Kingmill** are at Eureka, Nevada.

R. C. Gemmell has returned to Salt Lake City from San Francisco.

H. R. Hanley has gone to the New Cornelia and other mines in southern Arizona.

E. L. Newhouse, son of Edgar Newhouse, of the A. S. & R. Co., was in San Francisco this week.

Frank A. Moss, of Perth, Western Australia, is here, to visit his son, who is a mining student at Berkeley.

W. H. Blackburn, general superintendent for the Tonopah Mining Co., has gone to the Eden mine, in Nicaragua.

J. W. Richards has taken his son **Percy J. Richards** into partnership in his business as assayer at Denver, Colorado.

J. Harvey Whiteman, president of the Tonopah Mining Co., has returned to Philadelphia after a short visit to San Francisco.

W. A. Leddell has been appointed manager of the engineering department of the Mine & Smelter Supply Co., with headquarters at Denver.

E. H. Finch has been appointed chairman of the Mineral Division, Land Classification Branch, U. S. Geological Survey, as successor to **A. R. Schultz**, resigned.

Percival P. Butler, assistant superintendent of the Copper Queen smelter, has returned to Douglas from Los Angeles, having recovered from the effects of an operation.

W. C. Humphrey, general manager of the Guericuito mine in Sonora, has returned to Douglas, Arizona, to make his headquarters, after several years residence at Los Angeles.

George Gmahling, for some time employed as brick-foreman at the Calumet & Arizona smelter, sails this month for Peru to have charge of similar work at the new smelter of the Cerro de Pasco company.

George Motz, mining superintendent of the Nacozari Consolidated Copper Co., has returned from a visit in Texas and has gone to the company's property near Pilares de Nacozari to supervise the resumption of operations.

F. M. Brown, for many years supply-agent for the Chino Copper Co., at Hurley, New Mexico, has been promoted to the position of assistant purchasing-agent for the Utah Copper Co. **S. D. Akeroyd** has succeeded him at the Chino.

Walter Fitch, Sr., has retired as general manager for the Chief Consolidated Mining Co. at Eureka, but will continue to serve as president. **Cecil Fitch** has been appointed general manager of the property, and **J. Fred Johnson** will be superintendent.

William B. Gohring, for 14 years connected with the Calumet & Arizona Mining Co., has resigned his position as mining superintendent, effective January 3, to engage in business for himself with headquarters at Tucson, Arizona. He was succeeded by **E. E. Whiteley**, the assistant superintendent.

THE METAL MARKET



METAL PRICES

San Francisco, January 13

Aluminum dust, cents per pound.....	65
Antimony, cents per pound.....	10.50
Copper, electrolytic, cents per pound.....	10.25
Lead, pig, cents per pound.....	8.50-9.50
Platinum, pure, per ounce.....	\$150
Platinum, 10% iridium, per ounce.....	\$180
Quicksilver, per flask of 75 lb.....	\$90
Spelter, cents per pound.....	10.50
Zinc dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

January 13—Copper is in good demand. Lead is active and strong. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1910, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London	Average week ending	
Date	Cents	Cents	Cents	Pence
Jan. 7.....	131.25	76.87	Dec. 2.....	132.00
" 8.....	132.00	78.00	" 9.....	131.29
" 9.....	133.00	78.50	" 10.....	131.29
" 10.....	134.00	79.50	" 23.....	133.56
" 11 Sunday.....			" 30.....	132.50
" 12.....	135.00	82.50	Jan. 6.....	130.80
" 13.....	137.00	82.12	" 13.....	133.71
Monthly averages				
Jan.	1917 76.14	1918 88.72	1919 101.12	78.92
Feb.	77.54	85.79	101.12	85.40
Mch.	74.13	88.11	101.12	100.73
Apr.	72.61	95.35	101.12	87.38
May	74.01	99.50	107.23	85.97
June	76.44	99.50	110.50	85.97

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Jan. 7.....	19.50
" 8.....	19.50
" 9.....	19.50
" 10.....	19.50
" 11 Sunday.....	
" 12.....	19.50
" 13.....	19.50
Monthly averages	
Jan.	1917 29.63
Feb.	34.57
Mch.	36.00
Apr.	33.16
May	31.69
June	32.67
1918 23.50	20.43
1919 17.34	15.23
1917 27.42	26.00
1918 25.11	26.00
1919 23.50	26.00
1917 20.82	22.51
1918 22.10	20.45
1919 18.55	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Jan. 7.....	8.62
" 8.....	8.75
" 9.....	8.75
" 10.....	8.75
" 11 Sunday.....	
" 12.....	8.75
" 13.....	8.75
Monthly averages	
Jan.	1917 7.64
Feb.	9.10
Mch.	10.07
Apr.	9.38
May	10.29
June	11.74
1918 6.85	5.60
1919 5.13	5.24
1917 10.75	8.05
1918 9.07	8.05
1919 8.97	8.05
1917 8.38	8.05
1918 6.49	6.90

TIN

Prices in New York, in cents per pound:

Monthly averages		1917	1918	1919
Jan.	1917 44.10	1918 85.13	1919 71.50	70.11
Feb.	51.47	85.00	72.44	82.20
Mch.	54.27	85.00	72.50	55.79
Apr.	55.63	88.53	72.50	54.82
May	63.21	100.01	72.50	54.17
June	61.93	91.00	71.83	54.94
1917 62.60	93.00	70.11		
1918 82.53	91.33	62.20		
1919 81.54	80.40	55.79		
1917 78.82	54.82			
1918 74.18	54.17			
1919 85.00	71.52			

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
Jan. 7.....	9.85
" 8.....	9.75
" 9.....	9.70
" 10.....	9.72
" 11 Sunday.....	
" 12.....	9.75
" 13.....	9.75
Monthly averages	
Jan.	1917 9.75
Feb.	10.45
Mch.	10.78
Apr.	10.20
May	9.41
June	9.63
1918 7.78	7.44
1919 6.71	6.53
1917 8.08	8.72
1918 8.58	8.78
1919 8.33	9.38
1917 8.32	8.11
1918 7.76	8.75
1919 7.84	8.40

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Average week ending
Dec. 16.....	100.00
" 23.....	95.00
Monthly averages	
Jan.	1917 81.00
Feb.	126.25
Mch.	113.75
Apr.	114.50
May	104.00
June	85.00
1918 103.75	103.00
1919 90.00	72.80
1917 103.00	120.00
1918 115.00	120.00
1919 112.00	102.80
1917 102.00	120.00
1918 102.50	120.00
1919 117.42	115.00

MONEY AND EXCHANGE

Taking into consideration past experience in Liberty bonds and the vicissitudes of the bond market, it is believed the outstanding war issues have seen their worst prices and that within a few months a decided turning point will be manifested in all classes of Liberty bonds and Victory notes. This conviction is strengthened by the steps being taken to free Liberty bonds from artificial support, by gradually decreasing their use as collateral for bank loans, leaving the bond market to reflect legitimate investment demands. Funds set free from speculation will inevitably seek lodgment in high-grade investments.

The Treasury with its bond-purchase fund had purchased up to November 15, from War Finance Corporation, which has operated to support the market for Liberty bonds, \$953,080,500 of first, second, third, and fourth-land 4% and 4½% bonds. These bonds have been retired and canceled. Similarly with funds returned to the Treasury in repayment of loans made to the Allies there have been purchased, retired, and canceled, \$64,812,150 Liberty third and fourth-land 4½% bonds. This bond-purchase fund will expire one year after the termination of the War.

By act of Congress March 3, 1919, a more scientific plan for retirement of the War debt will become operative beginning July 1920. For each fiscal year thereafter until the debt is discharged, an amount equal to 2½% of the aggregate of bonds and notes outstanding, less the par amount of obligations of foreign governments held by the United States, on July 1, 1920, will be appropriated and become available for such a sinking-fund. It is calculated that this sinking-fund will retire funded war debt of the United States in about 25 years, except with respect to an amount of Liberty bonds equal to loans, or cash advances to foreign governments outstanding July 1, 1920. When and as these foreign obligations, which on December 17, 1919, totaled \$9,443,005,926, bearing 5% interest, are repaid to the United States, an offsetting amount of Liberty bonds may be purchased and retired in advance of their maturity. Annual interest due the United States on these loans to the Allies will, when paid, considerably exceed our present prescribed sinking-fund.

Estimated expenditure for the bond-purchase fund is \$740,000,000 for the fiscal year ending June 30, 1920, and the estimated appropriation for sinking fund is \$287,500,000 for the fiscal year ending June 30, 1921.

Discussing respective values and yield of war issues at present, C. F. Childs & Co., of New York, point out that the Victory notes and bonds of the Third Liberty Loan are today quoted at prices to net the investor more than 5%. The former have not been supported by Government purchases. These two issues virtually represent the present credit-level of the Government based upon a supply and demand market. It would, therefore, seem reasonable that a similar parity yield may develop with respect to the market for Second and Fourth Liberty Loans. Should Federal Reserve banks eventually advance their discount rate to 6% (which would not be likely to hamper trade) such a rate would tend temporarily to subject all non-mercantile loans to more careful scrutiny and the bonds of all Liberty loans would be adjusted to prices reflecting a more correct and equalized market level and showing more uniformity of income yields. However, until the Government's purchase of the different bonds is discriminatingly made, there will probably be a marked difference between the yields of the several issues.

Foreign exchange quotations on January 13 are as follows:

Sterling, dollars:	Cable	8.74%
	Demand	3.73%
Francs, cents:	Cable	8.93
	Demand	8.91
Lire, cents:	Demand	7.45
Marks, cents:	Demand	2.00

Eastern Metal Market

New York, January 7.

Due largely to highly speculative markets in London, the metal markets here are in most cases buoyant.

Copper is the least affected by foreign speculation, but is strong and higher.

Buying of tin by consumers is light but prices are soaring, due to higher foreign quotations.

The lead market is the strongest of all, with supply inadequate and prices advancing.

The zinc market has started the present week with wide advances, due to foreign demand and speculation on the other side.

Antimony is quiet but stronger.

IRON AND STEEL

Inquiry for both export and domestic consumption in the first week of the year has been heavy in all the principal markets. On much of it the mills have been unable to quote. Scarcity prevails in bars, pipe, sheets, rods, wire products, and semi-finished steel. More is heard of reduced operations at automobile plants because of a lack of steel. Car shortage is causing trouble also.

Pig-iron output in December, according to 'The Iron Age', was 2,633,268 tons for 31 days, or 84,944 tons per day, indicating a further recovery from the effects of the coal strike. The November output was 2,392,350 tons or 79,745 tons per day. Estimating charcoal pig-iron at 360,000 tons, the 1919 output was close to 31,000,000 tons as compared with 39,054,000 tons in 1918.

Definite orders for 250,000 tons of rails have been placed in the Chicago district on which rolling will commence at once. In addition tentative orders call for 100,000 to 150,000 tons more.

COPPER

Demand from both foreign and domestic consumers is reported as still excellent and likely to continue through January at least. Buying in November and December is estimated to have totaled 450,000,000 lb. Stocks on hand are still large and demand is not equal to production, but, if the present rate of buying continues long, demand will at least approach supply. Whether this much desired condition will be attained is hard to predict. Electrolytic copper for first quarter delivery is quoted at 19.50c., New York, with Lake held at 19.75 to 20c., New York. In London electrolytic was quoted yesterday at £126 for spot, with futures at £128 per ton, which corresponds with 21.62c. in our market for the latter.

TIN

The sensation of the week has been the continued speculative advance in the London market with a leap of £17 15s. per ton on January 5 for spot Straits. This is probably a record advance for one day. The market there Monday was £365 15s. for spot Straits which eased off yesterday to £364 10s. In sympathy with the British market prices have advanced. Yesterday spot Straits, New York, was quoted at 63.50c., having been 63.75c. on Monday. These prices are largely nominal as the market presents very little activity. Dealers have been the buyers and they are reported to have bought up all cheap lots and thus to have brought the market up to the import cost. Importers who have sold have done so at figures considerably below the cost to import. As a result there are now scant offerings, the trading being between dealers with consumers holding off. A little business was done Monday on future shipment from the East at 64 to 64.25c., but now most dealers are asking 64.50c. and higher. The amalgamation on January 1 of the American Metal Co. and L. Vogelstein is regarded as a formidable

combination and as possibly an attempt to regain part of the trade lost during the War. Deliveries of tin into consumption during December were 6965 tons, of which 1665 tons came in at Pacific ports. In stocks and landing on December 31, there were 3438 tons. For 1919 the imports of tin were 35,404 tons as compared with 58,027 tons in 1918. Of the 1919 imports 26,225 tons came from the Straits, with 4700 tons from England. The advance in tin in London from November 5 to January 5, has been £88 15s. per ton for spot Straits.

LEAD

'Supplies insufficient to meet the large demand' is the keynote of the situation in the lead market. Spot lead is almost impossible to obtain which renders it very difficult to quote the market. Few if any producers have any. On Friday and Saturday, January 2 and 3, the American Smelting & Refining Co. raised its price $\frac{1}{2}$ c. per lb. each day, bringing its quotation to 8c., New York, or 7.75c., St. Louis. But the outside market has continued to keep in advance. This market may be nominally quoted at 8.50 to 8.75c., New York, or 8.25 to 8.50c., St. Louis, for prompt or early delivery with very little metal available. For February-March delivery 8.87 $\frac{1}{2}$ to 9c. is the quotation firmly held. The present tight condition is predicted to continue through January and February after which relief is expected, due to present arrangements to increase production. In the two months ending January 5, spot lead in the London market has advanced £14 10s. and futures also £14 10s. per ton. There is some export inquiry in this market but how it is to be supplied is difficult to say.

ZINC

Foreign demand and market operations, particularly in London, continue to be the dominating influence in this market and prices continue to rise. Due to a sudden speculative advance in London on Monday and yesterday, prime Western became buoyant here and advanced from 9c., St. Louis, where it had held most of last week, to 9.50c., St. Louis, or 9.85c., New York. Foreign demand, particularly British, is most important and heavy. In the last two months ending January 5, the London zinc market has advanced £14 10s. for spot delivery and £16 per ton for futures. Domestic demand is still light and the position of producers seems technically excellent. Predictions are to the effect that American users of zinc are likely to pay high because they did not purchase when prices were much lower a few months ago.

ANTIMONY

The market is stronger but quiet at 9.75 to 9.87 $\frac{1}{2}$ c., duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is nominally quoted at 31.50 to 32.50c., New York, for wholesale lots for early delivery. The Aluminum Company of America is reported to have sold its entire 1920 output to regular customers at 32 to 33c. for virgin ingots. Some British metal is said to be available at concessions from these prices.

ORES

Tungsten: The market is quiet but cheerful over the prospects for the new year. Quotations are nominal at \$7 to \$15 per unit in 60% concentrate, depending on the grade of ore, but business is very light. Quotations for ferro-tungsten are still a matter of negotiation, though some reports place them at \$1 to \$1.15 per lb. of contained tungsten.

Manganese: Indian ore is offered at 65c. per unit and it is stated that American producers of ferro-manganese are likely to meet this price. Good ore is scarce both here and in England.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 220 Market St., San Francisco,
by the Deacy Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JANUARY 24, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

Page

NOTES 105

HERBERT HOOVER FOR PRESIDENT..... 106

The importance of the office, nationally and internationally. Candidates now before the public. Issues at stake. Party alignments. The main issue is the economic. Mr. Hoover's career and qualifications.

PROHIBITION 107

The fateful day has come. Kicks against the dry law. The manner in which it was put into effect. The effectiveness of persistent propaganda. Railroad tactics and the objections to them. How the 18th Amendment was rushed through Congress. The rights of the citizen and the will of the majority.

SYSTEM IN MINING 108

Good practice by the North Butte Mining Co., in Montana. Economy due to systematization of effort. The incentive to work diligently. Time study and dispatch. The blasting of a round of holes and the saving of explosives.

ARTICLES

THE BUNKER HILL ENTERPRISE—III

By T. A. Rickard..... 109

Facts extricated from romantic fiction regarding discovery and location of claims. Cooper & Peck grubstake Noah S. Kellogg in summer of 1885. Kellogg and Phil O'Rourke find the Bunker Hill lode. Variety of narratives giving various detailed versions of the episodes. The famous jackass owned by Cooper & Peck. The Sullivan claim located by Con Sullivan and Jacob Goetz. Historic suit. Decision of Judge Norman Buck. Jim

Wardner becomes promoter and operator. Concentrator built. Property sold to Simeon G. Reed of Portland. The fate of the four locators.

EXPERIMENTAL FLOTATION OF LOW-GRADE QUICKSILVER ORE

By E. G. Stowell and Will H. Coghill..... 117

The problem to be solved. Cinnabar ore containing 0.15% mercury. Screen-analysis and conclusions. Table-concentration tests discouraging. Flotation tests. Detailed procedure. Methods of grinding and influence on flotation. Acidity in pulp neutralized by grinding in ball-mill. Effects of lime-water, tap water, and sulphuric acid on flotation results. Lime-water beneficial. Fine grinding also of benefit. 90% extraction obtained.

A CONTRIBUTION TO THE STUDY OF FLOTATION—III

By H. Livingstone Sulman..... 122

The discussion of the physics of the process continued. Surface-energy and surface-tension of solids. Dynamical aspect of surfaces. Modification of surface characteristics during ore-dressing processes. Interfacial tension.

STATISTICAL REVIEW 125

Production of metal mines during 1919 in (a) Montana, (b) Nevada, and (c) New Mexico.

DEPARTMENTS

REVIEW OF MINING 127

THE MINING SUMMARY 135

PERSONAL 136

THE METAL MARKET 137

EASTERN METAL MARKET 138

INDUSTRIAL PROGRESS 139


Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25c. or \$6.

ELECTRICAL SUPPLIES *for the* **MINE, MILL & SMELTER**



EVERYDAY needs as well as special equipment of all sorts make up the Massco Electrical Line. Down to the smallest detail of mine operation, there's nothing missing.

Massco Service is a Complete Service

Rely on Massco for everything electrical and you are assured of dependable goods at right prices. Isn't it worth while to concentrate purchases and secure the benefit of a service that embraces all your needs even to the smallest electrical requirement.

Massco Electrical Catalog No. 56
Sent on Request

The Mine & Smelter Supply Co.

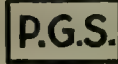
Denver

Salt Lake City

El Paso

New York Office: 42 Broadway

AGENTS FOR
THESE ELECTRICAL MANUFACTURERS





BASE-METAL mining is prospering, thanks to the better prices for lead and zinc. The European demand for lead is the cause of the recent rise in quotations, from 4.85 cents per pound last May to 8.75 in January of this year. Zinc was 6.31 last May and stands at 9 cents now. These are notable advances, and mean much to the miner.

IN this issue we publish the third of a series of articles on the Bunker Hill Enterprise, by the Editor. There will be twelve of these articles, which will cover the history of the Bunker Hill & Sullivan Mining & Concentrating Company, and describe the mining, milling, and smelting operations, as well as the geological and sociological phases of this highly interesting and unusually successful enterprise.

RECENT reports from the Transvaal indicate that the production of gold during 1919 amounted to \$160,000,000, a decrease from \$173,500,000 in 1918, and from \$192,200,000 in 1916. This compares with a production in the United States of \$58,500,000 during 1919, and \$68,500,000 in 1918. Australia shows a similar reduction. The record year of gold production for the world was 1915, in which period a total of \$470,000,000 was produced. Since 1915 the world output has steadily fallen; in 1916 it was \$454,000,000; in 1917, \$423,000,000; in 1918, \$372,000,000; and in 1919, probably \$350,000,000.

SHARES in Rand Mines, Ltd., are being offered in New York by advertisement in the newspapers. It is stated that dividends during the ten years preceding December 31, 1918, averaged \$4.62, at \$3.75 to the pound sterling, on each American share, which is equal to two and a half English shares. These so-called American shares are now offered at \$40 per share. Rand Mines is quoted in London at £3½, which at \$3.75 is equivalent to \$13.96, so that 2½ shares are worth \$34.90. The offer seems unattractive. Moreover, the rate of dividend paid during 1918 represents a yield of less than 6% on the market quotation. This is far too little for a business that is decadent, even allowing for the assistance derived from the premium on gold. Those who read the 'Mining and Scientific Press' do not need to be told that the mines of the Rand show impoverishment in depth; therefore the purchase of shares in the companies operating them, especially a holding company like Rand Mines, Ltd., is not wise. The financial houses controlling the big min-

ing consolidations in South Africa have unloaded their stocks on the British public, which in the course of seven years lost \$203,931,610 by holding shares in the three principal consolidations, namely, Rand Mines, Crown Mines, and East Rand Proprietary. See our issue of June 8, 1918. We shall be surprised if the same people succeed in unloading their wasting assets upon the American public.

LAST YEAR scored several records. Ship-building increased from 2,721,000 to 4,050,000 gross tons. Sales of Liberty bonds advanced from \$1,407,952,500 to \$2,658,400,000. The National Debt grew from 21 to 26 billion dollars. The population advanced to 107,600,000 from 106,050,000, not including overseas possessions. Wheat production increased from 921,438,000 bushels to 940,987,000. Wholesale prices rose from 207 to 222. Sales of stocks in New York increased from 144,118,469 to 319,337,000. The Stock Exchange had 152 'million-share' days, as against the previous record of 114 in 1906. Immigration increased from 110,618 to 249,000, but emigration kept pace, there having departed 258,000 as against 109,253 in 1918.

IMAGINATION is the very life of mining. The prospector, upon whom all mining depends, would make but a sorry success of his work without the power to visualize productive mines under the sand of the desert or under the brush of the wilderness. Many a famous mine would never have existed but for the vision of some man whose imagination led him far beyond his more stolid brethren. This fact has made mining a fruitful field for the 'confidence' man, by whose exuberant prophecies the proverbial widow and orphan have been trapped. Gold mines of such fabulous wealth as to suggest the use of a wheelbarrow; copper mines that surely, as soon as a shaft or two has been sunk, and, possibly, a stope started, will rival the Anaconda; oilfields that contain subterranean lakes of oil; these are all too familiar to the readers of prospectuses, in some of which new mining districts of undoubted merit are so overdrawn, and facts and fantasy so intermingled, that it is indeed a canny speculator who can say that he has never been misled. We had thought that the vivid imaginations of these Munchausens of mining had probed every possible kind of ore deposit; yet in a reliable report that we have just received concerning a strange discovery in New Zealand, we once again see the vindication of an old

proverb. Kauri gum, which at present has a market value of about \$1000 per ton for use in varnishes, oils, and similar products, is formed from the sap of certain trees of the pine family that grow in New Zealand. The customary method of obtaining the gum has been by distillation of the wood of the parent trees, a process that, as it destroys timber of industrial value, has yielded a restricted output at high cost. At the northern end of North Island, near Auckland, there are large swamps in the peaty soil of which kauri gum is found in loose lumps. In swamps covering an area of 2100 acres, the gum has been found to exist to a depth of six feet, and experiments made by treating the soil by wet methods of concentration have yielded a recovery of 10%. This deposit, although known locally for some time, is just beginning to attract attention; in all probability therefore the methods of sampling have not been sufficiently reliable to warrant accurate estimates. Nevertheless, making allowances for the fact that dependable figures are not forthcoming as yet, the possibilities indicated are interesting. In another part of the swamp the peaty soil is being excavated and retorted for crude oil, a process not sufficiently different from our own oil-shale operations to incite comment. But the strangest part of this chronicle is yet to come. The gum in the soil has resulted from the disintegration of some prehistoric forest of kauri trees; indeed, excavations have established the fact that submerged under the surface of the swamp there are the remains of a forest of kauri trees, maintained in perfect preservation by the water. As the oldest Maoris have no recollection of a forest ever having existed on this part of the island, the disturbance that resulted in the submergence of the trees, before they had time to decay, must have occurred at least several generations ago. Prospectors have been removing these trees and working them into lumber, which has proved to be in good condition. So we have the extraordinary spectacle, even if only on a prospecting scale, of men mining useful timber from underground. We recall reading, some years ago, one of Frank Stockton's delightfully whimsical stories, in which the hero discovered the remnant of a glacier that had been buried and preserved for centuries, and so became possessed of an ice mine. Thus fact and fiction rub shoulders.

Herbert Hoover for President

The Presidency is the most important political office in the world, partly on account of the mere size and wealth of the United States, partly because this country is the acknowledged leader of the democratic idea in human government, but chiefly because no other potentate or president exercises so much personal influence upon the industrial progress of his own country. During recent years the executive branch of the Government, rightly or wrongly, has exercised a preponderant influence as against the legislative and judicial branches, with which it was intended, by the Constitution, to be equal and co-ordinate. It is a fact that the welfare of the American

people for the next four or five years depends more upon the choice of a President than upon the exercise of any other act of citizenship. We must select the right man. Who is he? Already the political atmosphere vibrates to the calls of candidates and their supporters. It appears to be the fashion not to wait for an invitation, but to come forward with a claim to nomination; several gentlemen have shied their hats into the ring and already are campaigning vociferously. Most of them can be ignored; their confidence in their eligibility for the supreme office in the Republic is not shared by many outside their own cliques. So far the names put forward by the professional politicians have evoked but little enthusiasm. A worn-out General, a backstairs diplomat, a Tory pedagogue, a hardy quadrennial, even the sadly battered present incumbent of the Executive Chair are among the more prominent presumptive nominees, but none of these is the man of the hour. The Presidency requires physical, as well as mental, strength. It is dangerous to elect any man not physically fit for the arduous duties of the office, which is one that makes extraordinary demands upon the vital powers. It is dangerous to have an invalid in the White House, for that means either the delegation of authority to subordinates or the performance of duty under conditions prejudicial to efficiency. The choice should fall upon a man in the prime of life, and it should recognize the problems that are insistent at this time. National economics asserts itself today unmistakably; the welfare of this country depends upon the effective and humane organization of industry; upon the far-sighted and sagacious adjustment of international economic relations. The issues inherited from the Civil War are dead; the tariff is no longer a live question; the old shibboleths are unpronounceable; we are facing a new era, which is the aftermath of a great war, in the course of which the economic factor became supreme. The pre-eminent exponent of that factor, nationally and internationally, is Herbert Hoover. First as the organizer of relief for American refugees, then as the savior of Belgium, then as the head of our Food Administration, and lastly as chief of the Relief Organization in Europe, he proved his intelligence, his sagacity, and his generosity to the utmost. Of the Government bureaus that played an important part in the national effort demanded by the War, one was conspicuously untouched by calumny and unscathed by criticism—that was the Food Administration. Mr. Hoover's work in this department proved itself extraordinarily effective; it received not only popular approval but enthusiastic support. Mr. Hoover showed himself highly competent as an executive; he won a firm hold upon the confidence of the people of this country, as of those in Europe, because he possessed the constructive imagination of an engineer. Talk about a business-man for President! The swivel-chairs of Washington were burdened with business-men, and a sad mess most of them made. The Presidency calls for something more than the qualities sufficient for success in business; it demands the trained mind and the disciplined imagination of the professional man, not of the academic type, but of the kind

that has had experience in leading and directing industrial energies. A knowledge of business, as such, is useful, of course, but it must be the business of right living as well as the business of easy money. The experience of commerce alone will not suffice. Mr. Hoover has the qualities required for the highest office. He is not an orator, and what a blessing it would be to have a President who was not forever speechifying! He lacks the facile insincerities of the politician, but he can express himself clearly when occasion arises. Democratic institutions are suffering from an excess of rhetorical confectionary; we are tired of the lawyer and his unending gab; it would be a relief to have an executive that would give less time to phrase-making and more to the business of government. That is a business of increasing difficulty, because the expansion of the suffrage and the interdependence of industries is creating new problems. During the term of the next President the relation of capital to labor, and of both of them to the public good, will be the supreme subject; we shall have to face our responsibilities to the world at large, with which the War has brought us into new and complex connections; we shall have to establish economy in our national exchequer and thereby correct the extravagance stimulated by war; we shall have to recognize the heterogeneity of our population and devise means for assimilating and educating the alien elements. The United States stands on the threshold of a great era; to make the most of it there is needed for President a man of intellectual honesty, an experienced administrator, a wise leader. Such a man is Herbert Hoover.

Prohibition

At this time the compulsory abstention from spirituous liquors is a subject of daily conversation. A sudden change in the habits of the average citizen, particularly when enforced against his will, is bound to cause irritation and evoke protest. In our last issue we published a 'kick' on the subject from one of our readers; it is the only 'kick', except the luxury tax, that he is permitted to enjoy in his now uninteresting potations. We are not without sympathy for him; the difference between us is that we reconcile ourselves to facts rather more readily, and we accept some of the drawbacks of democratic rule for the sake of the many benefits arising from this form of popular government. One after another the efforts to block the enactment of the prohibition law have been checkmated, until at last the fateful 16th of January has arrived. The fight for liberty to drink alcoholic beverages is not ended. There remain other attempts to circumvent the permanent establishment of prohibition. Some of them are foolish. For example, the 'New York Times' quotes a declaration that is being signed all over the country; it reads thus: "Believing that the Constitutional Amendment passed by Congress and ratified by a majority of the States is an infringement upon my personal liberties, I hereby pledge myself to vote against any candidate for public office, regardless of party affili-

ations, who favors its enforcement." Our New York contemporary says: "The pledge is certainly too sweeping, and in form and language is of bad example." It is worse than that, it is childish. As grown men under a system of representative government, we must accept quietly and good-temperedly the decision of the majority. That it is a real majority, there is no doubt. It remains, however, to take warning, first of all, of the insidious effectiveness of persistent propaganda, and to be on our guard in the future against such changes in our laws or in the Constitution as may be brought about in a similar way. It is better to be sure than sorry. Prohibition is a standing example of the fact that if you say the same thing often enough it will be believed by the average man. Not many think for themselves; if bombarded by the thoughts of others, they surrender. Again, the manner in which prohibition was rushed into law calls for serious objection. The time required to elapse between the ratification of a Constitutional Amendment and the date on which it goes into effect is supposed to provide an opportunity for adjustment to the new conditions imposed by such a change in our fundamental law. In the case of national prohibition, this salutary provision was impaired by war-time prohibition, which, by coming into force during the period of grace, to all intents and purposes antedated the operation of the 18th amendment to the Constitution. The President, wisely and properly, vetoed war-time prohibition as soon as the Expeditionary Force had been demobilized; in doing so, he recognized the facts of the case. His veto was set aside by well-meaning fanatics. The enforcement of war-time prohibition nearly eight months after the signing of the Armistice left no interval between the incidence of that enactment and the imposition of perpetual prohibition by means of the Constitutional Amendment. This savors too much of 'railroading' tactics, which are repugnant to those who, most properly, view with anxiety the overthrow of such basic provisions in our law as are meant to protect the people from any curtailment of their liberties without deliberation and the rigid observance of the safeguards created for that very purpose. The 18th amendment was 'rushed'; of that there is no doubt. For example, many States have a proviso in their own constitution giving their people the right to a referendum. Ohio exercised that right, and reversed the vote of its legislature. Since the date, January 16, was determined by the day when the last of the 36 necessary States ratified the amendment, it would appear as if the defection of Ohio creates a flaw in the legality of the amendment. Moreover, the unseemly haste to bring national prohibition into force has had the effect of doing injury to persons engaged in an industry heretofore recognized as legitimate. The culture of the grape, the production of wine, the manufacture of spirituous liquors generally constituted forms of industrial activity and financial investment that the Federal government and many of the States had approved, and had even fostered. In common justice the men that had placed their money in this business and those that depended upon it for a livelihood

should have been given a fair chance to make the severe adjustments entailed by the new law. The time covered by war-time prohibition should have been treated as 'time out', to use a sporting term, when determining the date at which perpetual prohibition should begin under the 18th amendment; and, of course, the preservation of the rights of the citizen, to conserve which this republic was founded, called for such a ratification by the necessary 36 States as left no suggestion of a flaw. The pros and cons of prohibition may be the subject of discussion, but there should be no room for debate concerning the observance of the basic principles upon which representative government is founded. There are things more vital than either the permission or the forbiddance to drink. One of them is a strict regard for the constitutional rights of the citizen; another is the acceptance of the vote of the majority. We think that although prohibition was brought about by methods and means open to serious criticism, and although the history of the entire movement should serve as a warning against the repetition of such a performance, yet it does express the will of the majority of the people in our State and in the United States, and therefore it should be accepted good-temperedly. We are sorry for our elder brethren whose habits of a lifetime—habits by no means bad—have suffered a ruthless break; we envy the undemocratic advantage of the rich in being able to store large stocks of liquor in their own cellars, while the rest of us must go 'dry'; we are glad to have had our share of good burghundy before the question of abstinence from wine became irretrievably involved with that of drinking bad whiskey in saloons; we congratulate the wives of men who formerly spent their wages in getting drunk; and, most of all, we shake the hand of the mothers who now can thank Heaven that their sons will escape the temptation that has ruined many promising careers. Selah.

System in Mining

The latest report of the North Butte Mining Company ascribes a remarkable reduction in the cost of producing copper during the past year to the development of systematized methods for handling labor, for distributing supplies, and for performing each phase of underground operations in accordance with standard plans. Other companies likewise have effected economies by a similar systematization of effort. Broadly speaking, the efficiency of mining operations, like that of any other industry, depends upon two factors, namely, skilful management and willing employees. To be precise, the maintenance of an efficient personnel is a function of administration, but as a result of unprecedented conditions brought about by the War, and the accompanying unrest among working-men, the labor question has become a highly important and complex problem in itself. Assuming that this has been solved as well as may be under a particular set of conditions, there is still an immense field for betterment in the scheme of organization; in the selection of material and equipment; in the system for

distributing this material and equipment; and in the method of performing each detail of the mine-work; all of which can be considered separately from the supply of men to carry on the work as planned. If there is no incentive sufficiently strong to induce the miner to work with at least some diligence, comparatively little will be accomplished under any circumstances; on the other hand, if the employees are inclined to be fair and work reasonably hard during the full period of their shift, a remarkable improvement in results can be obtained in most mines by the application of a system suited to the special conditions. When the manager of a mine considers the fact that the output of such a comparatively simple plant as a machine-shop in an automobile factory has been increased as much as tenfold by the introduction of plans, schedules, and standard practice, he must see possibilities in the adaptation of the same ideas to his own business. The objection has been raised that conditions characteristic of mine operations make the adoption of 'time study' and 'dispatch' methods impracticable, but it seems rather as if these peculiarities have simply served to conceal extraordinary waste of material, of effort, and of time, which are preventable to a large extent. It is true unfortunately that so-called 'efficiency' work generally arouses opposition among miners and even foremen, who are inclined to resent the idea of having 'pencil-men' plan their work for them. For example, consider the ordinary round of holes drilled in advancing a drift. The experienced miner confidently believes that he can go into the heading, and, by sizing-up the various seams and cracks in the face, determine the number, direction, and position of the holes required to break the next round most effectually. As a matter of fact, it is highly probable that his round will not meet the requirements more than 60% as well as a standard round that has been devised intelligently by an engineer specially qualified for such work. One large mining company calculated an actual yearly saving of \$240,000 in its powder bill, as a result of the scientific use of clay tamping. It was necessary, of course, to determine just what amount of tamping could be advantageously used in each hole of a standard round, without in any degree lessening the effectiveness of the blast, for there is no economy in saving powder at the expense of the proper breaking of the ground. The average miner if left alone is prone to gauge the quantity of powder simply by the capacity of the drill-hole. In some mines careful investigation showed that from 25 to 50% of the average miner's time was devoted to assembling or waiting for tools, equipment, timber, pipe, and the like. A large proportion of this waste of time has been avoided by substituting systematic distribution for haphazard ways. These are but a few of dozens of illustrations that might be given of the improvements that actually have been brought about by the application of efficiency, which, when shorn of its obscuring nomenclature, is nothing more than an organized and painstaking use of common sense in getting a given result with a minimum expenditure of time, money, and effort.

The Bunker Hill Enterprise—III

Discovery of the Lode and the First Operations at the Mine

By T. A. RICKARD

The facts concerning the discovery of a great mine are usually obscured by a glowing tissue of fiction, which is readily accepted because it appeals to the love of the romantic and the fabulous. Not uncommonly the truth is stranger than the fiction and a real romance is smothered by sublimated gossip. The story of the Bunker Hill is no exception; but, fortunately, in this case the facts can be extricated by a careful reading of the various statements of those who participated in the event.

We have seen how mining in Idaho began with the

tions that Kellogg might make in the course of his prospecting trip, for which they provided him with a 'burro', or donkey, and \$18.75 worth of provisions. These consisted of 15 lb. of flour, 7 lb. of bacon, 2 lb. of coffee, 8 lb. of beans, 4 lb. of dried apples, \$1 worth of sugar, one pair of \$2.75 shoes, and a half-dozen of printed location notices. He was to prospect on the south fork of the Coeur d'Alene river for gold, because it was in gold mining that they were interested and that Kellogg had the necessary experience. By the 27th day of the month Kellogg had consumed the supplies furnished by Cooper and



MAP OF THE COEUR D'ALENE

successful digging for gold in the gravel of the mountain valleys. Murray was one of the centres of such productive operations. The firm of Cooper & Peck operated a store of general merchandise in that town. During the summer of 1885, John T. Cooper and Origin O. Peck grubstaked a prospector named Noah S. Kellogg. In frontier communities 'grubstaking' is a recognized form of mining speculation; it consists in supplying a prospector with food and tools, in return for which he undertakes to give his backer a half-interest in any mineral discovery he may make. Such was the deal that Kellogg made with Cooper and Peck on August 1, 1885. They were to receive a quarter interest each in any loca-

tion. Besides other provisions he had purchased elsewhere on his own account. So he testified in court at a later date. His prospecting had been almost a failure, for during the month he had only located the 'Mary A.' and 'Kellogg' claims on Elk creek,¹ and neither of these proved to have any value at that time. He returned to Murray, with a few samples of what appeared to be iron-stone, of which Cooper and Peck thought less than nothing. On August 29 he returned, at the request of his backers, to search for a vein showing free gold, such as the veins that had made men rich in the hills around Murray. He was told not to bother about "iron rock", but to go

¹This is the first creek east of Milo gulch; see map.

again to Big creek, where he had previously picked up some pieces of quartz that looked promising. For this trip Cooper and Peck provided him with 19 lb. of flour, 8 lb. of bacon, 8 lb. of beans, 4 lb. of sugar, 4 lb. of coffee, one coffee-pot, one camp-kettle, one pair of shoes, and two location notices. This time he remained in the hills until the 12th of September, by which date he had exhausted his stock of food. Evidently he had neither time nor inclination to supplement his 'grub' with fish or game. On this second return to Murray he told Cooper and Peck that he had failed to discover any gold-bearing quartz; he gave them copies of the location notices of the 'Mary A.' and 'Kellogg' claims, to which he had added their names as owners. He returned the donkey, which, as we shall see, played a prominent part in the subsequent story. Kellogg claimed that he then and there terminated his 'grubstake', or prospecting agreement, which meant that Cooper and Peck had no further interest in his actions or in any discoveries he might make subsequently.

This explanation of his actions as a prospector was disputed when subsequently the grubstake became the subject of an important lawsuit.

Now we come to other actors in this frontier drama. Philip O'Rourke was a miner of considerably wider experience. He had been to Leadville, in Colorado, and knew something about the mining of silver-lead ores. Jacob Goetz, commonly known as 'Dutch Jake', was a mining adventurer, of genial nature and many resources; he and his partner Harry Baer had a grubstake agreement with O'Rourke. To O'Rourke and Goetz came Kellogg soon after his second* prospecting trip in the hills above the south fork of the Coeur d'Alene river. He showed them the pieces of "iron rock". Goetz testifies that Cooper and Peck had taken similar samples to John M. Burke, a man with a local reputation for knowing ores, and he had said that it was 'smelting ore', which had disgusted Kellogg's backers, who, as recorded already, only wanted 'free-milling' gold ore. When, however, Kellogg's samples were shown to Phil O'Rourke, he recognized them as coming from the cap of a lead lode. The samples reminded him of the oxidized ore he had mined at Leadville; the "iron rock" excited his interest; therefore he suggested to Goetz that they join Kellogg in staking the ground. Goetz had horses and provisions, both of which he turned over to O'Rourke and Kellogg, who started forthwith down the valley. Mr. Goetz says² that Kellogg notified Cooper and Peck at this time, which he does not specify, that he had "quit the grubstake deal with them", but the evidence laid before the jury showed that the notification to Cooper and Peck was given on September 13.

Kellogg took O'Rourke first to Big creek, east of Elk

creek, where he showed him the ironstone outcrops, some of which later became identified with the Yankee Boy, Southern Cross, and other productive silver-lead mines. Then the two prospectors proceeded a short distance farther down the south fork of the Coeur d'Alene river until they came to Milo creek, which is next to Elk creek. Turning up Milo creek, they went to the Bunker Hill outcrop, which crosses the gulch from side to side, as can be seen to this day. Who found the lode and how he found it are questions that cannot be answered confidently despite a study of the testimony given in the subsequent lawsuit.

Mr. Goetz, whom I interviewed at Spokane, told me that O'Rourke was the discoverer. He found 'float', or loose fragments of oxidized ore, at the bottom of the mountain-side near the place where the first mill was built later. At a point 400 to 500 ft. above the creek on the west side he struck his pick into an irony outcrop and broke away pieces that showed the glint of galena. He traced this ore for a distance of 500 ft. up the slope. Having done this, he sat down on the outcrop dumb-founded by the realization of his discovery, which seemed to him "the biggest thing in the world". It must be remembered that O'Rourke's experience at Leadville had given wings to his imagination. He was too excited to make a location, but he did insert a stake in the ground before he descended the hillside in search of Kellogg. The day was September 9, 1885. Next day O'Rourke located the 'Bunker Hill' claim with Kellogg as witness. Goetz tells the story thus:

"Kellogg took O'Rourke down to Big creek, on the South Fork, and pointed out the big iron capping that covered the ledges. Moving down the river, they came to Milo creek, where Kellogg now stands. There they lost a pack-horse, and while old man Kellogg went in search of it up Elk gulch, Phil started the hunt up Milo gulch. At the head of the creek he found some galena float, and though it was dreadful hard work to get through the brush and fallen timber he climbed up the hill about 500 feet and there he stumbled upon the great Bunker Hill ledge, sticking right up out of the ground. There was nothing in sight but glittering galena, and O'Rourke knew he had found the greatest thing ever discovered in the Northwest. He was so excited that he sat down half an hour before he knew what to do. Finally he rushed back to Kellogg, who was in camp at the mouth of the gulch, and after supper they spent the time planning how to locate their find. Phil was so excited that he had forgotten to put up any posts. That night he wrote out the location notice, and called the claim the 'Bunker Hill', after the battle of the Revolution. But he decided it would be best to have Kellogg sign the notice as locator, for Phil had a lot of friends who loaned him money, and they might try to claim an interest if it was staked in his name.

"Next morning they started up the gulch about two miles to make the location, but their cayuses had strayed away. As luck would have it, they found the old white burro that Cooper & Peck had turned over to Kellogg as

*Whether it was the first or the second trip is a critical question; I am giving the story now as told by Goetz and others, and as generally accepted. Later, I shall revise it in the light of further evidence.

²'Dutch Jake's Account', Spokane's Home Builders, November, 1910.

a part of his grubstake. The burro had wandered away when Kellogg was there first. They caught the beast, and loading their picks and grub on it, they went up the gulch to the Bunker Hill lode. Then Kellogg happened to think that may be he'd better not appear as locator, for Cooper & Peck might claim an interest on account of his first grubstake. So they threw away the location notice, with Kellogg as locator, and wrote a new one with O'Rourke as the locator and Kellogg as witness."

On their return to Murray they reported to Goetz, and a consultation ensued. O'Rourke was burdened by gambling debts; among others to whom he owed money was Cornelius Sullivan, another Irishman, known to his

arrived, he and Sullivan re-located the extension, calling it the 'Sullivan' claim. That was on October 2.

Another account of the discovery appears in an autobiographical sketch by James F. Wardner, a frontiersman and mining adventurer. He says³ that "to Kellogg's jack's trick of losing himself when most needed, however, and to his alleged sagacity in knowing a pay-shoot when he saw it, is due the discovery of the great mine; and in Dutch Jake's famous resort in Spokane there is a lifelike oil painting of the jackass standing



JIM WARDNER



JACOB GOETZ

friends as 'Con'. So it was decided to take him into the deal. That night Goetz and Sullivan started for the scene of the discovery, but they missed their way and lost time. Meanwhile Peck heard about it and found his way thither; by chance he picked up the location notice that Kellogg had discarded and learned through the talk of the others that his burro had been used by Kellogg and O'Rourke. Whereupon Peck, on his return to Murray, on September 26, started to bring suit for Cooper & Peck against the locators, claiming a half-interest on the basis of the grubstake agreement with Kellogg. Peck failed to locate the extension of the 'Bunker Hill', because "O'Rourke had put up some fictitious posts to hold the ground", so says Goetz. Therefore, as soon as Goetz

upon the apex of the Bunker Hill and gazing abstractedly across the canyon to the glimmering outcroppings of the Sullivan".

It will be noted that to the poor donkey, like Balaam's ass, is attributed more sagacity than to his master. Sullivan is reported, by Wardner, as having said to him:

"'Well, Jim, we don't know how you come to strike our trail, but we've got something here worth a long journey to see. Look up there!' And, as he spoke, Sullivan pointed to the right-hand slope of the canyon from the camp, just as the sun had risen to a point where its morning rays fell full upon the side of the mountain.

³Jim Wardner of Wardner, Idaho', by Himself, 1900

What seemed to be a vast sheet of new tin dazzled the eyes. I had never seen such a sight before—nor since.

'Galena,' I said.

'That's what,' replied O'Rourke."

"His may be picturesque, but it is pure fiction. Wardner proceeds to record Kellogg's statement:

" 'It was this a-way,' began Mr. Kellogg; 'the damned jack shook us one night at the mouth of the creek, and the next morning we started out to find him. His tracks were plain, and now and then we found great wads of his hair where he had climbed over the down timber and scraped his sides against the logs. How under the heavens the little devil managed to get through that place I can't tell; but after we got into the canyon proper his trail was easy. Looking across the creek we saw the jack standing upon the side of the hill, and apparently gazing intently across the canyon at some object which attracted his attention. We went up the slope after him, expecting that, as usual, he would give us a hard chase; but he never moved as we approached. His ears were set forward, his eyes were fixed upon some object, and he seemed wholly absorbed. Reaching his side, we were astounded to find the jackass standing upon a great outcropping of mineralized vein-matter and looking in apparent amazement at the marvelous ore-shoot across the canyon, which then, as you now see it, was reflecting the sun's rays like a mirror. Jack fairly heaved a sigh of relief as he heard our vigorous comments. We lost no time in making our locations, and where the jack stood we called it the Bunker Hill, and the big shoot we named the Sullivan in honor of Con.' "

This also is a cheerful fabrication. Kellogg is not likely to have said anything of the kind at the time recorded, for it was not true; later he may have started to adorn his tale, or, what is more likely, Wardner may have embellished it with the mention of the glittering galena and the donkey's rhapsody. In the first place, neither Wardner nor Kellogg nor the gentle jackass ever saw a glistening mass of galena outcropping there or anywhere else in nature. Galena oxidizes when exposed to the weather and loses its bright lustre, becoming the dull sulphate or the equally dull carbonate, which usually is colored red by the oxidation of a small proportion of associated iron pyrite. The outcrops of lead lodes consist commonly of dark-red ironstone with gray spots of anglesite (the sulphate) or cerussite (the carbonate) in the midst of which small unoxidized remnants of galena may survive. Portions of the Bunker Hill outcrop can still be seen near the place of discovery; they consist of iron-stained quartzite with specks of galena. The talk of a glittering mass of silvery mineral sticking out of the mountain-side so brilliantly as to mesmerize the ass, and others not much wiser, is pure moonshine. What did happen probably is that the donkey, intelligent enough to find fodder for himself, strayed through the pine forest above the creek toward the outcrop, because near it there was a

bit of open space covered with bunch-grass, as can be seen to this day.

However, the story of the burro is now fixed in local history and even in the local concert-halls jingles of an earlier day:

"When you talk about the Coeur d'Alenes

And all their wealth untold,

Don't fail to mention Kellogg's jack,

Who did the wealth unfold."

Jim Wardner, in his autobiography, says that Judge Norman Buck, of the District Court of Idaho, who decided the celebrated case between Cooper & Peck and the prospectors who located the Bunker Hill, recognized the agency of the ass, and that his decision was as follows:

"From the evidence of the witnesses, this Court is of the opinion that the Bunker Hill mine was discovered by the jackass, Phil O'Rourke, and N. S. Kellogg; and as the jackass is the property of the plaintiffs, Copper & Peck, they are entitled to a half-interest in the Bunker Hill and a quarter interest in the Sullivan claims."

By courtesy of the Clerk of the Supreme Court at Boise, I have been enabled to read a copy of the proceedings in this case. This is what Judge Buck, on June 12, 1886, gave as his opinion: "That the plaintiffs are entitled to a decree as against N. S. Kellogg and Phil O'Rourke for an undivided fourth interest of in and to the Bunker Hill mining claim, as described in the complaint as they held the same September 10, 1885, and all interest acquired since said date in and to said claim and judgment for costs against defendants."

The plaintiffs were John T. Cooper and Origin O. Peck. The defendants were N. S. Kellogg, Phil O'Rourke, Cornelius Sullivan, and Jacob Goetz. The questions submitted to the jury by the defence were answered in favor of the defendants, sustaining their contentions, whereupon the defendants asked the Court for a decree stating that the plaintiffs had no cause for action and assessing the costs of the suit against them. The judge, however, denied the motion and set aside the findings of the jury. Instead, he rendered the decree as quoted above.

It is evident that Jim Wardner made free with the Court's "conclusions of law" in order to give a touch of verisimilitude to his picturesque yarn. Judge Buck did not mention the donkey in his findings; he found that on September 10, when Kellogg and O'Rourke jointly located the 'Bunker Hill' claim, Kellogg was still "under a contract with the plaintiffs whereby and under which the said plaintiffs were entitled to the undivided one half interest in and to all mining property located or acquired by said Kellogg during the term of said contract," which did not expire until September 13, the day on which Kellogg gave notice to that effect.

This disposes of the main question, namely, that of discovery; but the lawsuit involved the title to other claims, located subsequently to the 'Bunker Hill'. Cooper and Peck alleged that Kellogg discovered the lode prior to August 29 and located five claims called the

⁴Goetz says that this claim was named "in honor of John L. Sullivan, the pugilist". It will be noted that he mentions "a pack-horse" and "cayuses", as well as the donkey.

'Bunker Hill No. 1', 'Bunker Hill No. 2', 'Fraction', 'Accident', and 'Richmond'; and that, in order to evade his liability under the grubstake, he took O'Rourke with him to Milo creek on September 10, upon which date they took down these location notices and substituted new ones. First they located the 'Bunker Hill' claim in their joint names and then on the same day they re-located it in the name of O'Rourke alone. The rest of the locating, it was alleged, was postponed until September 15, that is, until after the grubstake had been terminated form-

"posted a notice claiming certain grounds as the Accident lode in his own name, but allege the truth to be that said notice was posted on the 16th day of September, 1885, and long after the termination of said agreement between plaintiffs and said Kellogg".

The issues of fact were submitted to a jury, which, *inter alia*, decided as follows:

1. That the grubstake terminated on September 13.
2. That the supplies furnished by Cooper & Peck were exhausted by Kellogg on September 9.

3. That Kellogg did not discover "any rock in place bearing gold, silver, or other mineral upon any of the lodes described in the complaint."

4. That Kellogg assisted O'Rourke in locating the 'Accident' claim and in measuring the 'Bunker Hill'.

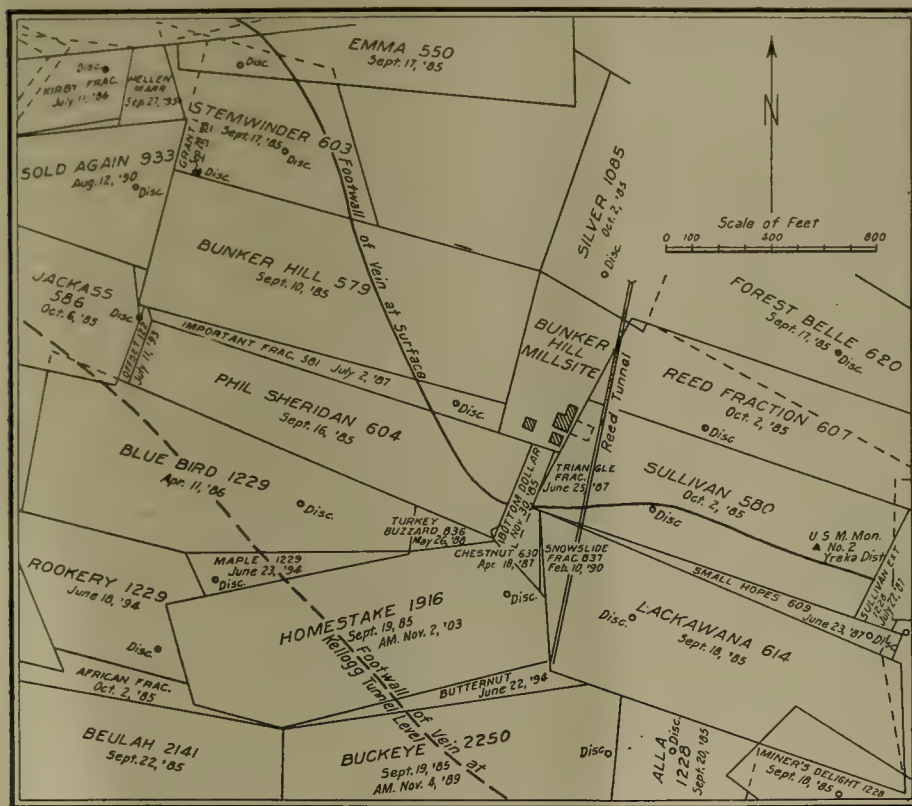
5. That O'Rourke located the 'Bunker Hill' on September 10, the 'Richmond' on September 18, and the 'Accident' on or about September 19.

6. That O'Rourke received no information from Kellogg "which led him to such locations".

7. That O'Rourke took down the 'Accident' notice posted by Kellogg on September 16, and that he requested Sullivan and Goetz to re-locate it on October 2.

8. That a "consideration for assisting in discovering and developing this claim" was paid by Sullivan and Goetz to O'Rourke.

As to the 'Accident' location, the Court decided: "That the defendant N. S. Kellogg knew of the existence of the Accident or Sullivan lode claim and the lode therein prior to the 13th day of September, A.D. 1885, and having such knowledge withheld the same from the plaintiffs at the time he claims to have given notice of the termination of the grubstake contract, and immediately thereafter, to wit, on the 16th day of September, 1885, he went upon the ground and posted a notice of location thereof, in his own name, and under and by virtue of posting said notice he then and ever since has been the owner of an interest in such location, and that the claim upon which said notice was posted was fully and legally perfected and title acquired thereto by defendant Kellogg."



EARLIEST LOCATIONS COVERING THE BUNKER HILL MINE

ally by Kellogg. On that day the 'Accident' location notice was pulled down and a new one, in which O'Rourke's name replaced Kellogg's, was substituted. Next day the same was done to the 'Richmond', and on September 20 the 'Fraction' likewise was credited to O'Rourke. This did not end the changes; on October 2 the 'Accident' location notice, it is alleged by plaintiffs, was torn down and the claim re-located as the 'Sullivan' in the names of Sullivan and Goetz.

The defendants entered a formal denial to these allegations; they stated that "on the 13th day of September, 1885, the defendant Kellogg returned said jackass to the plaintiffs and notified them that he would no longer prospect for or in behalf of the plaintiffs, or for the benefit of himself and plaintiffs, and thereupon terminated the said prospecting co-partnership".

In regard to the locating, they denied the supposed earlier locations by Kellogg, but they admitted that he

The dates of location as given in the various accounts of the discovery are discrepant; for instance, Mr. Goetz says that the 'Sullivan claim' "was staked September 10, 1885, just ten days after the Bunker Hill was staked". The 'Bunker Hill' was located on September 10 and the 'Sullivan' on October 2. The correct dates of the surviving locations, as recorded in the county office, appear on the accompanying map.

It remains to disentangle the truth from these contradictory versions. Wardner gives no dates. He was a friend of the locators and became interested with them in the Bunker Hill discovery, so, of course, he repeated their version of the affair, plus his own embellishments. Goetz had grubstaked O'Rourke and participated in the venture, besides being himself a locator of one of the later claims; therefore he told a story that would defeat the demands made by Cooper & Peck on the basis of their grubstake agreement with Kellogg.

I have studied the statements made by Cooper, Kellogg, O'Rourke, and other witnesses in the course of the trial. Their testimony is full of contradictions, and obviously contains many falsehoods. On inquiry among those who knew the actors in this frontier drama, I find that all the prospectors were 'broke', chronically. Kellogg was slow-witted and lazy. O'Rourke was not a man of much mining experience, although he had been to Leadville; he was fonder of whiskey than of work. Con. Sullivan was "a good sort", but no miner. 'Dutch Jake' and his partner Harry Baer were "the knowing ones of the bunch", meaning not that they were wise in mining, but shrewd in business. Cooper and Peck were respectable storekeepers; the senior partner was addressed as "Dr." Cooper. His testimony is that of a fairly educated man; it is not rambling, like that of the others. The jury's findings need not be taken too seriously as against the judge's decision, for the twelve 'peers' would be in sympathy with the 'boys' and would regard discrepancies of statement as of no great moment; according to their code, it would be as proper for a miner to forswear himself in order to help a 'pal' as for a 'real' gentleman to perjure himself in an effort to protect a lady's reputation. I have not the slightest doubt that Judge Buck's decision was just; in short, it appears to me that the evidence can only be harmonized by concluding that Kellogg and O'Rourke 'put up a game' to circumvent the grubstake as soon as they knew a valuable discovery had been made.

In the account written by Mr. Goetz, it will be noted, he says that "the burro had wandered away when Kellogg was there first", although just before he has been explaining how O'Rourke alone had discovered the lode and was then taking Kellogg with him, for the first time, to show him the outcrop and help him in making a location. Early in August, Cooper provided Kellogg with six location blanks; he used two of them on the 'Kellogg' and 'Mary A.' claims; what did he do with the other four? Did he use them to make locations in Milo gulch and did he pull them down afterward, when he decided, with O'Rourke's aid, to avoid his obligations to Cooper &

Peck, by re-locating the claims after he had given notice of the termination of the grubstake?

It is difficult to disentangle the talk about "iron rock" and Cooper's alleged disclaimer of interest in anything but gold-bearing quartz. I venture to interpret the evidence as follows: Kellogg, when he returned to Murray, on August 28, showed Cooper some pieces of ironstone broken from an outcrop on Elk creek. These probably came from what is now known as the Iuka outcrop on the Alhambra property. He appeared to have brought back with him some other samples of ironstone (from Milo gulch?) that contained a little galena; he may have shown these to Cooper, and Cooper may have disdained them also; but when he showed them to O'Rourke, that son of Erin knew enough—thanks to his sojourn at Leadville—to recognize the lead ore. He asked Kellogg where he had found it and arranged to go back with him. Cooper testified that he suggested sending Peck with Kellogg to see his locations, but Kellogg replied that there was no necessity for doing so. Kellogg himself testified that when he reached Myrtle on his way out from Murray, on August 29, he was hailed by O'Rourke, who offered to go with him. O'Rourke said that Kellogg showed him some "iron rock" from the South Fork country and asked him what he thought about it. He learned that Kellogg was "going back" next day, so he proceeded to collect sundry necessary supplies and "waited" at Myrtle "until Kellogg came along". They proceeded to the South Fork. Kellogg went to Big creek and he (O'Rourke) went to Milo gulch, where, on the fourth of September, not the ninth as Mr. Goetz says, he discovered the Bunker Hill outcrop. He "got a piece of galena that day; it was coated with iron, broke it open and found galena inside"; later he found some more similar float by ascending the hillside. At the end of the day he went to the mouth of the gulch—he says—slept there, and next day "went back to camp on Elk creek, and wrote a note to Kellogg", who turned up four days later, on September 9, by which time O'Rourke had broken the outcrop in several places and determined the strike of the lode. "He [Kellogg] had got back from Big creek," testifies O'Rourke, who says that he located the 'Bunker Hill' on the 10th, adding that Kellogg was not present when he wrote the notice, on which his name appeared as 'witness'. That seems unlikely. Together they returned to Murray next day and showed specimens of the ore to their friends, but not to either Cooper or Peck.

The stories told by Kellogg and O'Rourke are fishy. Under cross-examination the latter acknowledged that "the first notice" he posted on the 'Bunker Hill' was "probably blown off the post in the first instance". He testified: "Don't know the exact date when it was done, for was not very particular about it until I found it was in the hands of plaintiffs, wrote another notice describing the ground exactly the same to the best of my opinion, posted and recorded it."

It is not worth while to go into further detail. The Judge that tried the case had all the evidence before him,

and the faces of the witnesses as well; he decided that the discovery was made by Kellogg while still bound by his grubstake agreement with Cooper & Peck. It appears to me most probable that the Bunker Hill lode was discovered by Noah Kellogg on or about August 26, 1885, and that he was led to it by his search for the donkey, who, more energetic than his master, climbed the hillside in search of fodder, and found a patch of bunch-grass in a small clearing close to the outcrop, where, on account of the mineralization, the ground was comparatively free from trees. That much of the story may have been true. In the subsequent quarrel, the burro served as a herring drawn across the trail of the prospectors. Perhaps "herring" is inappropriate; then let us say that he

and there raise the necessary capital, if they would give him an option. The talk began with one bottle of whiskey and was clinched with a second. As Wardner records, "pledges over the last of the whiskey were made", and he went then to the mine to collect the samples. Before starting he posted a notice locating 10,000 inches of water in the Coeur d'Alene river. These rights, he says, he sold later for \$50,000. By the way, apropos not of the water but the whiskey, what a difference there would have been in the stories of Western mining discovery if prohibition had been antedated 50 years! On reaching Spokane, Wardner had his samples assayed and was delighted to find that they ran high in silver, as well as lead. He proceeded to San Francisco



THE CELEBRATED DONKEY STANDING IN THE MAIN STREET OF WARDNER
The star marks the position of the mine

served as the aniseed bag for the hunt that followed. Certainly his alleged part in the actual discovery of the lode is mostly fiction; yet it is amusing to see how he remained for 35 years the hero of the tale, or a hero with a tail. As to the "glittering galena" by which he was hypnotized, that resembles the "red" lobsters that an eater rather than a fisher of lobsters said that he had seen deep down in the sea-water. The outcrop of silver-white galena recalls the proverb which says that there may be such things as volant non-ruminating artiodactyles, but at the same time declares them to be very unlikely birds.

The case of Cooper & Peck against the locators was appealed, but, in the meantime, Jim Wardner joined hands with the locators and started to raise the working capital necessary to develop a mine. According to his own description of his doings at that time, he explained to Kellogg, O'Rourke, Sullivan, and Goetz that their lead ore was no good unless it was worked on a big scale, which involved the building of roads and a mill. He offered to take samples of the ore with him to Spokane

in order to see the Selby Smelting Co. This company was only too glad to buy the ore at a price that left a good margin of profit to the owners of the Bunker Hill. Wardner returned to the mine and contracted to buy 25,000 tons of ore, he to advance the owners \$5 per ton and they to produce not less than 20 tons daily. About 800 tons of ore was taken out of the orebody in the Sullivan claim; when this was exhausted it became apparent that, although the lode was wide, only stringers of galena continued in depth. Wardner received \$115 gross per ton on the 800 tons and felt confident that more ore could be found. Then followed an anxious time while a tunnel, or adit, was run into the lode at a lower level. Wardner had abandoned hope and was on his way to Spokane when he was recalled by the foreman, Brady, who came down the trail shouting excitedly to him that they had "struck it big in the main tunnel". He had just met Tom Erwin and was having a drink of whiskey (again whiskey at the critical moment!), so he took another stiff drink before going to the mine, where he

found that "the boys had broken into a solid shoot [he spells it 'chute'] of galena for the full size of the drift". "It was a wonderful sight," he says. "After going in on it for a little way, I started a cross-cut, and the shoot proved to be 36 ft. wide. Then we drove the drift night and day. I had 40 men at work, and after mining 100 ft. on the vein we cross-cut again. It was still 36 ft. strong." He sampled the ore and found that "while the orebody was marvelous in its dimensions, the values were cut down to a concentrating proposition". If it was "solid galena", it would not need to be, nor could it be, concentrated. Of course, this stuff of Wardner's makes interesting reading, but it is quite evident that he does not allow himself to be hampered by facts. However, if what he says did not actually happen, it might have happened and something like it did happen. To the reader it will give something of the atmosphere of whiskey, resource, and adventure that surrounded these pioneers of industry.

Wardner, so he himself says, went to Spokane, Portland, and San Francisco to raise money, presumably to build a concentrating mill. He says that he made an attempt to induce capital to take hold of what he believed to be "one of the most desirable investments ever offered". As if a lode containing masses of silver-lead ore of uncertain persistence in the mountains at a distance of 60 miles from the nearest railway could be called "one of the most desirable investments ever offered". However, that was a miner's optimism, and in this case it happened to prove true in the end!

At a loss what to do, Wardner remembered "an active young fellow named Austin, since then inventor of the pyritic smelting process". This refers to my friend William Lawrence Austin, an accomplished metallurgist and the introducer, as Wardner says, of the pyritic smelting process—in 1892, if I remember correctly. Wardner went to Toston, in Montana, where Austin was then, in 1886, running a smelter. Austin examined the samples of ore from the Bunker Hill and made some assays, after which he assured Wardner that if his statements were true (a wise proviso), he had "the biggest concentrating proposition in the country". Austin advised Wardner to go to Helena and see Governor Sam Hauser.

Mr. Austin tells me that he recalls the visit from Wardner. He appeared unexpectedly one day, dragging a bag containing lumps of fine-grained galena. He wanted to know what was the best way to treat an ore of that character. "It was a clear case of smelting and I told him so," writes Mr. Austin. "I also told him that Governor Hauser was the man for him to see, as the Governor was running a smelter at Wickes on lead ore. I did not assay Jim's ore, nor did I say anything about concentrating, for the ore brought to Toston was solid galena." In further notes, Mr. Austin says that Jim Wardner was original and entertaining. He was generally liked. There is a story that while at Rossland, in later years, he persuaded the Canadian Pacific Railway agent to telegraph to headquarters for a pass to Toronto. The reply read: "Don't let Jim walk." The operator

was something of a joker and handed the telegram to Wardner thus: "Don't. Let Jim walk." 'Jim' was optimism personified; he would tackle anything. Mr. Austin concludes by saying: "He was one of those original characters, products of Western life when doors didn't have locks on them and one was sure of a welcome wherever one went. I don't think Jim was a paragon, but if I had to choose between him and the fanatics that are 'reforming' the world, I'd take Jim." Same here.

Wardner told his story to the Governor, who sent an 'expert' to examine the mine, the result being that Hauser agreed to provide the machinery for a 100-ton concentrator. Wardner's proposal was that he was to secure "a contract to concentrate 50,000 tons at \$5 per ton and also a share in the net profits". Things went well. The mill helped the mine to make money. It attracted the attention of capitalists and was sold to Simeon G. Reed, of Portland, for \$650,000.

Of the four locators, Mr. Goetz is now living at Spokane, where he is the proprietor of the Coeur d'Alene hotel, a rendezvous for the people of the mining districts and an attractive hostelry. He seems to have prospered not only in wealth, but in friends and reputation. Kellogg died a pauper 20 years ago. O'Rourke is a broken-down man in a Catholic institution at Vancouver, Washington. Sullivan went to Butte and engaged in mining, using the money he made out of the Bunker Hill; but he did not succeed. In 1901 he joined a party that went to Alaska. While they were engaged in prospecting, two pirates broke into their camp and murdered all except a man named Rooney, who was found under a canoe by some friendly Indians. He was unconscious and nearly dead, but survived to tell the ghastly story. The party had \$3000 in cash with them and supplies enough to last for a year, all of which were stolen. So the Bunker Hill did no good to its immediate discoverers, for Mr. Goetz, luckily, it would seem, escaped from that category.

The burro fared best of them all. When superannuated he was pensioned off by Kellogg and placed on a farm at Cottage Grove, Oregon, where he died full of years and honors, even his burial being made an occasion for the expression of lofty sentiments in accord with the myth that had been built to his memory. In his book, under the photograph of the donkey, Wardner writes: "The \$4,000,000 donkey in the foreground." Yes, he remained in the foreground a long time, and I am almost sorry to relegate him to the background.

The Bunker Hill story, as twisted and elaborated by the gossip of the campfire, has always centred around the donkey. It seems a pity to spoil a story so well established. Miners are not unlike other men in their faculty for evolving myths, which "represent the protest of romance against the commonplace of life". As Sir Walter Raleigh is better remembered for the tale of the cloak and Queen Elizabeth than for the founding of Virginia, so the legend of the donkey has done more for the fame of Noah Kellogg than the desultory prospecting that ended in the finding of the Bunker Hill lode.

(To be continued)

Experimental Flotation of Low-Grade Quicksilver Ore

By E. G. STOWELL and WILL H. COGHILL

INTRODUCTION. A co-operative agreement between the U. S. Bureau of Mines and the Oregon Bureau of Mines and Geology provides for joint experimental work to encourage the application of improved methods of mineral concentration to the low-grade ores of Oregon, in cases where the problems involved are of such a character as to make the information thus gained useful in solving similar problems in other States. This paper gives the results of one of these investigations. It deals with the experimental flotation and table concentration of a cinnabar ore. The work was done in the laboratories of the Seattle Station of the U. S. Bureau of Mines, and of the College of Mines, University of Washington, Mr. Stowell being detailed from the staff of the Oregon Bureau of Mines, and Mr. Coghill from the U. S. Bureau of Mines.*

The ore from the Black Butte mine, at Black Butte, Oregon, was selected because, first, the nature of the ore was such as to make its treatment a problem of general interest, and, second, the company had made an earnest effort to solve its problem, but had met with indifferent results. The sample was prepared by E. D. Crane, superintendent of the Black Butte mine.

THE MINE, smelter, and mill are at Black Butte, 17 miles south-east of Cottage Grove, Oregon. It is our understanding that there is a large tonnage of ore available carrying 0.15% mercury, and that a long life of the mine would be ensured if an economic extraction could be effected. The soft nature of the ore and the location of the deposit are favorable to low operating costs. Water-power is available during a part of the year, and the company has recently completed an auxiliary steam-plant utilizing the wood fuel abundant in the region.

On the property is a 40-ton Scott furnace, which has operated on a feed assaying between 0.25 and 0.50% mercury. Ore of this grade, however, makes up but a minor portion of the reserves, the remainder being too low-grade to be treated by present methods.

THE MILL. During the past two years the operators have maintained an experimental mill, which, at various stages, has combined gravity and flotation methods. One of the ore-circuits used in this mill is shown in Fig. 1. The essentials of the equipment are: jaw-crusher, Marcy

mill, Dorr classifier, a small rougher and a cleaner flotation machine of the Minerals Separation type, Dorr thickener, and drying-vat.

It is reported by Mr. Bray, mill superintendent, that the best recovery by flotation was 80% in a concentrate assaying 4.6%. This grade of concentrate and percent-

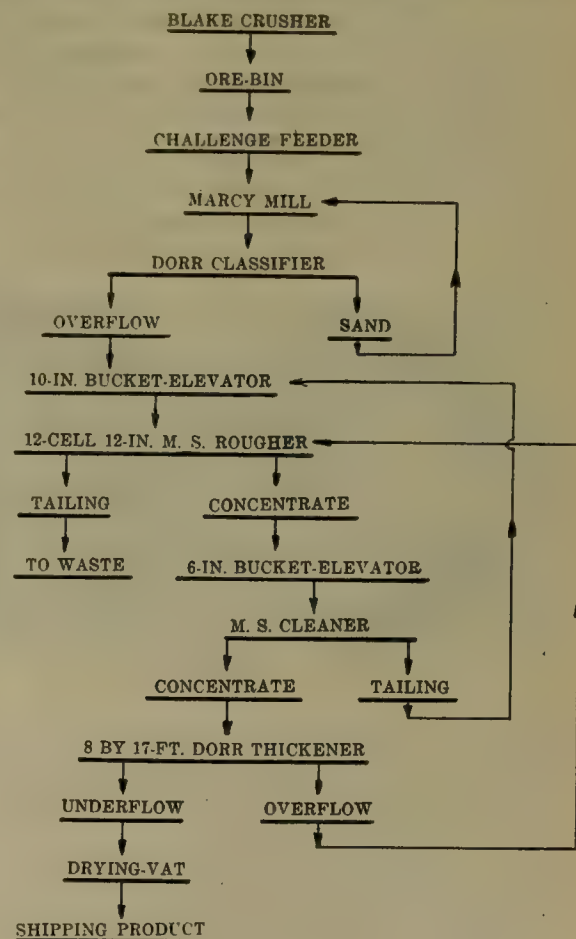


FIG. 1. FLOW-SHEET OF BLACK BUTTE PILOT MILL

age of recovery were not satisfactory; the improvement of these two factors constitutes the problem treated in this paper.

OCCURRENCE AND CHARACTER OF THE ORE. The quicksilver occurs as the sulphides, cinnabar and metacinnabarite, both of which have the chemical formula HgS . The cinnabar is bright red and the metacinnabarite is black.

*The writers wish to thank C. M. Bouton for assaying the ore samples; his work has proved that the method which he has devised for the assay of mercury ores is remarkably accurate for both low-grade and high-grade ores. Acknowledgment of assistance is also due to Milnor Roberts, Dean of the College of Mines, University of Washington, H. M. Parks, Director of the Oregon Bureau of Mines and Geology, F. K. Ovitz and C. O. Anderson of the Bureau of Mines.

The orebody is in a broken shear-zone in andesite.¹ The higher-grade ore occupies a width averaging 16 ft. across the main fault-zone and several hundred feet along the strike. Mineralization, however, has extended through both the so-called foot-wall and hanging wall, but the limits of mining are determined rather by assay than by the appearance of distinct lode-walls.

Flowage and brecciation of the original rock are apparent in hand specimens. The ore is soft and pinkish gray. Cinnabar is seldom discernible without magnification. Pyrite and marcasite may be easily identified, and they amount to about 1% of the mass.

The andesite is altered so that its former character is obscured. Ferro-magnesian silicate minerals have almost entirely disappeared, and in their place some chlorite and limonite in abundance have been produced. Feldspars have altered to kaolin and sericite. No evidence was found that the mineralization took place at different periods, unless the occasional occurrence of marcasite coated with cinnabar may be taken as such.

The mercury sulphide invariably occurs in the softer kaolinized portion of the rock, with other sulphides; sulphides are absent in the less altered portions. Accessory minerals are pyrite, marcasite, stibnite, sphalerite, and

terlocked calcite and sericite. It also contains cinnabar.

Plate B, shows the kaolinized portion, photographed in natural light. It contains pyrite, chalcopyrite, stibnite (?), calcite, sericite, metacinnabarite, and cinnabar. The unlettered dark grains are cinnabar; the others may be identified by means of the legend.

Many sections were made, and all of them showed that the cinnabar occurs in the softer portions of altered andesite; it is generally wholly imbedded in this softer material, but occasionally it occurs at the contact with the harder fragments.

An important fact to be borne in mind is that the harder material is soft in terms of the hardness of average ores; the results of screen and chemical analysis shown in Table I will then be readily understood.

Table I—Screen* and Chemical Analysis of Black Butte Cinnabar Ore
(Assay of composite sample, 0.15% mercury)

Minus	Mesh	Proportion of total weight	Assay in % Hg
Minus	20, plus 35.....	21	0.15
"	35, " 65.....	25	0.15
"	65, " 100.....	8	0.19
"	100, " 200.....	12	0.18
"	200.....	34	0.13

*Tyler standard screens were used throughout the work.

The sample for screen-analysis was crushed in rolls to pass 20-mesh and then screened. The chemical analysis shows a remarkably uniform distribution of the mercury on the successive meshes—a slight enrichment in the intermediate products and some impoverishment in the fine. A microscopic examination of the separate products showed that each contained locked cinnabar. The conclusions, therefore, are:

- (1) The cinnabar is very finely disseminated.
- (2) The more altered and softer portions contain the cinnabar, and the brecciated fragments are barren.
- (3) The cinnabar resists crushing equally as well as the gangue.
- (4) Fine crushing will be required to release the mineral.

PREPARATION OF SAMPLE. The lot of dry ore weighing about 250 lb. was crushed with a Blake crusher to pass $\frac{1}{2}$ -in. ring and further reduced by rolls to pass 10-mesh. After thorough mixing, a 10-lb. sample was reduced to 40-mesh in a disc-pulverizer. It assayed 0.145% mercury.

It will appear later in the report that though the head assay is 0.145%, assays are shown carrying as much as 0.19%. This variation is explained as follows: The material reserved for testing was stored in a tub that was subject to vibration in the laboratory. The vibration caused the heavy minerals to be concentrated in the lower stratum and thus gave the effect of 'salting'. When this was discovered, the lot was re-mixed and feed-samples of each test were assayed.

TABLE CONCENTRATION was tried before beginning flotation. Three tests were made on a 12 by 24-in. Wilfley table. The results are given in Table II.

The first test was of a preliminary nature to determine

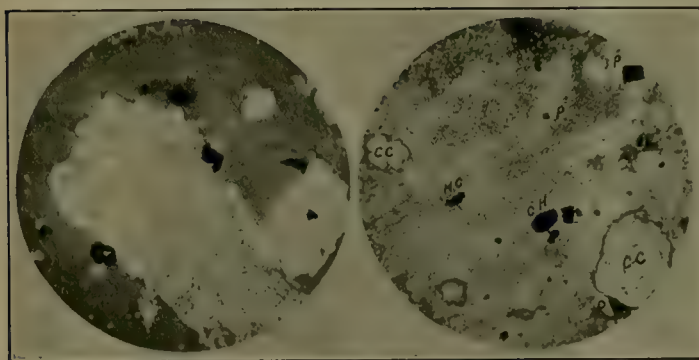


PLATE A

PLATE B

chalcopyrite; the last three are present in very small amount. Some quartz, apparently secondary, was observed, also magnetite, which was probably a constituent mineral of the original rock.

The micro-section, Plate A, makes a splendid distinction between what has been referred to as the softer kaolinized portion and the less altered fragments; the dark portion of the field shows the kaolinized portion with specks of cinnabar (retouched with india ink) disseminated through it, and the large, nearly rectangular, portion is a fragment of the original rock. The lath-like pieces of feldspar in this fragment should be noted. The spaces between them are filled with limonite resulting from the alteration of ferro-magnesian silicates. The square light-colored portion at the right consists of in-

¹Parks, H. M., and Swartley, A. M., 'Mineral Resources of Oregon'; Oregon Bureau of Mines and Geology, Vol. 2, No. 4, p. 33.

the deportment of the material. The recovery was low, 41.3%, and the middling assayed the same as the feed. The tailing was divided into sand and slime. The latter gave the higher assay, but probably not as high as it would if the gangue were of a more resistant material.

In the second test 3000 gm. of the ore was ground in rolls to pass 20-mesh. Five products were made by screen-sizing. These were treated separately, and concentrates, middling, and tailing were made. The intermediate screen-product showed the best recovery, and the combined products gave a recovery of less than 50%. The middlings were a little richer than the feed.

In the third test a larger quantity of ore was prepared. The results are as in test No. 3 except that flotation of the finest product gave an added recovery of 13.3%. The flotation concentrate was of about the same grade as the average of the table concentrates, but the method of flotation was inferior to that reported below.

Table II—Concentration Tests on a 12 by 24-in. Wilfley Table

Number of test	Weight used in test Gm.	Mesh	Ratio of concentration	Grade of concentrate % Hg	Recovered %
1	400	— 100	34 : 1	2.07	41.3
2	3000	(a) — 20	55 : 1	4.1	48.5
		— 35			
		(b) — 35	91 : 1	8.3	50.5
		— 65			
		(c) — 65	100 : 1	11.7	60.5
		+ 100			
		(d) — 100	57 : 1	6.6	60.0
		+ 200			
		(e) — 200	357 : 1	12.2	20.0
		Combined	100 : 1	7.3	49.1
3	22,080	(a) — 20	120 : 1	2.77	20.4
		+ 48			
		(b) — 48	22 : 1	1.87	50.0
		+ 65			
		(c) — 65	28 : 1	5.2	74.2
		+ 100			
		(d) — 100	143 : 1	8.20	43.4
		Combined	53 : 1	4.57	46.6
		Added recovery by flotation of minus 100-mesh			
					13.3

Further survey of Table II shows that the coarse gave a low recovery; the loss was probably in the locked grains. Smaller sizes—from 65 to 100 mesh—gave a fair recovery. But the smaller sizes are not at all suitable to table-treatment. Probably a vanner could be substituted. However, the results did not warrant further work by gravity concentration, so flotation was tried.

FLOTATION. It was stated above that the mill-concentrate obtained by flotation assayed 4.6%. Further, it was learned by conference with the operators that their work had been with heavy oils. Since the heavy oils had given such an undesirable grade of concentrate, and since qualitative tests showed their undesirability, it was decided to disregard them in the experimental work and give preference to the light oils.

A series of qualitative tests was made to determine the deportment of a few of the oils in neutral, acid, and alkaline solutions. In general, it was found that the heavier and more insoluble oils produced voluminous persistent froths, floating both cinnabar and pyrite, and entraining such great quantities of gangue that they precluded the cleaning of the concentrate to a desirable grade. On the other hand, a light soluble oil gave a light friable froth well armored with cinnabar and carrying only a small amount of gangue. The concentrate

could be cleaned to make a surprisingly rich product. Caustic soda and sulphuric acid solutions seemed to have no qualities to justify their use. In consequence, light (partly molecularly soluble) steam-distilled pine-oil was selected.

The ball-mill was a more desirable grinding device than either the porcelain jar or the disc-pulverizer. The reason for this preference, and the acidity of the ore, will be discussed later.

In the tests that follow no effort was made to alter the natural chemical condition of the charge after ball-mill grinding, that is, no chemicals were added. However, this does not mean that soluble inorganic compounds were absent.

PROCEDURE. A series of three tests was run to determine the desirable degree of grinding. The flotation charge of 3000 gm. was prepared by grinding minus 10-mesh material in the ball-mill. The pulp-ratio during grinding was 2 : 1 (water to solid), and during flotation, 4 : 1. The mechanical type of agitator was used, and the period of roughing treatment was 30 minutes.

Following the roughing operation, the concentrate was transferred to a smaller machine for cleaning. This treatment was continued as long as there were colors in the froth—20 to 40 minutes.

Table III—A Series of Tests to Determine the Desirable Degree of Grinding No. 1

Grinding period	Products	Weight Gm.	Percentage of total weight	Assay % Hg	Percentage of total mercury
15 min.	Feed	3000.00	100	0.16	100
	Concentrate	6.42	0.214	44.70	59.8
	Middling	17.40	0.58	0.54	1.8
	Tailing	2920.00	97.33	0.07	42.5
	Error or loss	+ 56.18	+ 1.88	...	+ 4.1
No. 2					
30 min.	Feed	3000.00	100	0.16	100
	Concentrate	7.70	0.256	43.60	70.2
	Middling	29.00	0.97	0.54	3.3
	Tailing	2945.00	98.17	0.04	24.5
	Error or loss	+ 18.30	+ 0.61	...	+ 2.0
No. 3					
45 min.	Feed	3000.00	100	0.16	100
	Concentrate	6.94	0.231	55.40	71.1
	Middling	199.00	6.63	0.43	15.9
	Tailing	2755.00	91.83	0.025	12.7
	Error or loss	+ 39.06	+ 1.31	...	+ 0.3

Table III gives the results of these tests. The period of grinding in the ball-mill is the only variable in the procedure. The recovery is 59.8, 70.2, and 71.1% for the respective 15, 30, and 45-minute periods of grinding. The ratio of concentration in the roughing is about 100 : 1 and the final ratio in the cleaning is about 400 : 1. The richest concentrate assays 55.4% mercury—a remarkably rich product for a two-treatment system handling such low-grade material. The consumption of oil is 0.7 lb. per ton of ore; it was added at intervals to the impeller compartment of the flotation machine.

The screen-analysis of the respective tailings is shown in Table IV. The increased fineness due to prolonging the period of grinding is here shown by the percentage passing 200-mesh, namely, 52.3, 71.2, and 82.5. The consistent increase of recovery as stated above and the more striking order of extraction values, namely, 61.6, 73.5, and 87, respectively, with increased fineness indicated that fine grinding was desirable.

Since the recovery and extraction showed a continued rise with increased fineness of the ore, it was determined to carry the fine grinding one step further. Therefore, 3000 gm. of the 10-mesh ore was ground wet in the ball-mill for 30 minutes, then screened on 100-mesh and the oversize returned for further grinding. The combined products were then treated nearly as before. The duration of the roughing treatment was only 20 minutes.

Table IV—Screen-Analysis of Tailings from Tests to Determine Desirable Degree of Grinding

Mesh	No. 1		No. 2		No. 3	
	Percentage of total weight	Percentage cumulative	Percentage of total weight	Percentage cumulative	Percentage of total weight	Percentage cumulative
Plus 65..	17.4	17.4	1.5	1.5	0.3	0.3
" 80..	7.0	24.4	2.5	4.0	0.5	0.8
" 100..	2.1	26.5	0.9	4.9	0.6	1.4
" 115..	6.7	33.2	4.0	8.9	1.8	3.2
" 150..	7.2	40.4	10.0	18.9	6.0	9.2
" 170..	2.9	43.3	3.1	22.0	3.1	12.3
" 200..	4.4	47.7	6.8	28.8	5.2	17.5
" 300..	4.6	52.3	7.9	36.7	8.1	25.6
Minus 300..	47.7	...	63.3	...	74.4	...

The rougher overflow was cleaned in the same machine, making concentrate and middling. The duration of the cleaning treatment was 20 minutes, the pulp density was 20:1, and the oil (steam-distilled pine-oil) used amounted to two pounds per ton of original ore.

The results are shown in Table V. There it will be seen that the ratio of concentration in roughing was about 8:1, and that the final ratio of concentration was 220:1. The concentrate assays 35.6% and contains 86.1% of the mercury. The middling is remarkably low-grade—even lower than the feed—and contains only 7.3% of the mercury. If it is assumed that 60% of this middling is recoverable in a concentrate of the same grade as the one shown, a 35.6% concentrate and 90% recovery from an ore assaying only 0.19% mercury is obtainable. A much richer product could be obtained if desirable, as shown by Table III, where one of the concentrates assays 55.4% mercury.

The screen-analysis of the stage-crushed material is shown in Table VI. At first thought it seems that crushing 88% through 200-mesh is excessive, but when the softness of the ore is taken into account, it is probable that the cost would not be prohibitive.

The oil was quick in making a froth and only when used in excess was there difficulty on account of free oil getting into the spitzkasten and killing the froth. A test was made in which a portion of the oil was ground with ore. Apparently no advantage was gained by this procedure, except that frothing started at once with agitation in the roughing-cell.

Comparative tests were made to determine the effect of different pulp-ratios. The ratios used varied from 4:1 to 12:1. In the same interval of time the recovery was greater in the more dilute pulps and the concentrates could be cleaned to better grade. Although the pulp-ratio in the main tests was 4:1, it may develop in practice that the ratio of 6:1 would be more desirable.

A series of tests was made to compare the pneumatic and mechanical agitation types of machines. Fineness of grinding, amount of oil, and other factors were maintained as nearly the same as possible. The results were distinctly in favor of the mechanical type. Extractions

from the pneumatic cell ranged from 37% on the coarsest pulps to 70% on the finest, while the other gave extractions ranging from 60 to 80% on pulps of the same character. The coarser particles of cinnabar showed a tendency to bed down on the canvas bottom of the pneumatic machine and floated with reluctance. This work, however, was not carried far enough to condemn the use of the pneumatic cell.

Table V—Flotation After Stage-Grinding

Feed	Percentage of total weight		Assay % Hg	
	Weight Gm.	Percentage of total weight	Assay % Hg	Percentage of total mercury
Concentrate	3000	100.00	0.19	100
Middling	13.82	0.461	35.6	86.1
Tailing	350.00	11.66	0.12	7.3
Error or loss.....	2575.00	85.83	0.01	4.3
	+ 61.18	+ 2.05	...	2.3

Table VI—Screen-Analysis of Tailing After Stage-Grinding

Mesh	Weight, %
Plus 100	00.0
Minus 100, plus 200.....	12.0
" 200, " 300.....	6.5
" 300	81.5

GRINDING AND ACIDITY. Reference has been made above to the dependence of the results upon the method and degree of grinding; the best results were obtained after fine grinding in the ball-mill. No effort was made to alter the natural chemical condition of the pulp after ball-mill grinding, whereas a similar procedure with a porcelain jar gave adverse results.

The chemical effects of the water-soluble salts of the ore must surely be considered unless we regard flotation as such a mysterious process that it defies the application of chemistry. It would be strange indeed if this ore did not contain water-soluble salts, for, as stated above, the gangue consisted of altered andesite; iron, magnesium, sodium, aluminum, and potassium salts, were therefore formed. If these salts have not been washed away by natural agencies they will appear as water-soluble constituents of the ore.

The water-soluble acidity (by the method of titrating employed in cyaniding) of the ore when washed with two parts of water was equivalent to 0.2 lb. of lime per ton of ore, but this 'acidity' could not be detected with methyl orange as indicator except by boiling down to a concentrated solution. The water-washed ore when treated with lime-water for five minutes gave a latent acidity equivalent to 2.3 lb. lime per ton of ore; the total acidity, therefore, was 2.5 pounds.

The first assumption was that this latent acidity was an adsorption effect and would thus depend upon the amount of solid surface. But tests showed that it was independent of the degree of crushing. It is then a chemical reaction; also it is progressive in its action, so that in a five-minute treatment 2.5 lb. of lime was consumed as compared with 4 lb. in one hour.

The addition of lime to the wash-water gave a precipitate that looked like a ferric salt; exposure to the air caused a reddish turbidity, also suggesting an iron salt. Iron was then identified. Analysis of the wash-water showed the presence of iron, magnesium, calcium, aluminum, and the sulphate radical. Further water-analysis showed that the ore, after wet-grinding in the ball-mill, gave much more soluble iron than when other methods of

washing—including grinding in a porcelain jar—were applied: some of this iron was in a ferrous state, as indicated by a green precipitate with ammonia. Any method of washing where metallic iron was absent showed the presence of ferric iron, but no, or very little, ferrous iron.

The above chemical deportment may now be easily explained: Ferric salts² hydrolize in water, and accordingly give an acid reaction. The acid dissolves iron from the steel parts of the mill. From the standpoint of flotation, the fact that iron (ferrous) is taken into solution is secondary to the fact that the acidity of the solution is thus neutralized, whereas in cyaniding the reverse is true.

The above reaction of ferric sulphate upon iron has been considered once before.³ Then a stamp-mill tailing was being cyanided. The cyanide consumption was low until the tailing was re-ground in a disc-pulverizer, and then it was excessive. Investigation proved that the ferric sulphate in the ore reacted with the steel surfaces of the pulverizer, forming ferrous iron, which is a vicious cyanicide.

Aluminum sulphate and potassium aluminum sulphate, respectively, in dilute solutions, react on steel in a manner similar to ferric sulphate, that is, with the production of ferrous iron. This was proved by agitating the solutions respectively in a clean ball-mill and determining the iron in solution.

Let us now go back to the problem in hand; the recovery of cinnabar was much better after neutralizing the acid by grinding in the ball-mill than it was when the acid persisted, as it did after grinding in the porcelain jar. The consideration of the deportment of ferrous sulphate in the flotation machine must not be overlooked. If it instantly oxidizes to ferric sulphate, the aforesaid acid condition will have recurred and the good effects of grinding in the ball-mill will be lost. If it oxidizes slowly, some advantage will be derived. It is likely that this oxidation would progress slowly, if at all, in the presence of the reducing conditions imposed upon it by the organic and inorganic reducing agents present. Unfortunately this cannot be stated accurately because it was difficult to titrate the solution for ferrous iron at the end of the flotation period. The consideration of the chemistry of the process did, however, lead to the solution of a mystery. It served as a guide for outlining the next flotation test, for it suggested neutralizing the acid in some other manner.

A preliminary flotation test was made, therefore, in a dilute lime-water solution and it indicated that the lime had a beneficial effect. Next, a series of tests was arranged to show the relative effects of lime-water, tap-water, and sulphuric acid solutions. The results are shown in Table VII. Note how in passing from left to right—from alkaline through neutral to acid solutions—the mercury extracted amounts to 90.2, 77.6, 61.8, 39.4, and 35.4%.

²Natural basic ferric sulphate is known to occur in two forms, jarosite and utahite.

³Coghil, Will H., 'Ferrous and ferric iron in cyaniding'; M. & S. P., Oct. 16, 1915, p. 598.

Table VII—Relative Effects of Lime-Water, Tap-Water, and Sulphuric Acid Solutions on Mercury Extraction by Flotation

Description	Lime-water added		Tap water		Sulphuric acid added	
	Alkalinity of solution pounds CaO per ton		Acidity of solution, pounds H ₂ SO ₄ per ton		Acidity of solution, pounds H ₂ SO ₄ per ton	
	Before flotation	After flotation	Before flotation	After flotation	Before flotation	After flotation
Number of test.....	1	2	3	4	5	5
Per cent mercury extracted	90.2	77.6	61.8	39.4	35.4	35.4
Grammes pyrite extracted..	1.21	0.89	3.22	3.44	3.27	3.27
Grammes solid in overflow	10.82	10.40	7.00	10.22	7.53	7.53

The ore was ground in a porcelain jar and the inorganic reagents were added at the beginning of the grinding period. The screen-analysis of the tailings showed that the degree of grinding was practically the same as that in test No. 3, Table III, where the ore was ground for 45 minutes in the ball-mill. The extraction, it will be recalled, was 87.0% when the ore was ground for 45 minutes in the ball-mill and no inorganic reagents were used, whereas, the extraction, after grinding in the porcelain jar in the presence of lime-water, is 90.2%. The question now arises: was it the fine grinding that gave the good results shown in test No. 3, Table III, and again in Table V, or was the progressive neutralization of the acid by the steel mill a factor?

Doubtless the advantageous effect of long grinding in the ball-mill was twofold:

- (1) The size of the ore particles was progressively and advantageously decreased.
- (2) The acidity was progressively neutralized.

Readers who wish to use these notes as a guide to commercial flotation of cinnabar ores will do well to make reference to a paper by C. A. Heberlein on 'Mining and Reduction of Quicksilver Ores at the Oceanic Mine, Cambria, California', in the Transactions of the American Institute of Mining Engineers, Vol. 51 (1915); also Bulletin 78 of the California State Mining Bureau, entitled 'Quicksilver Resources of California'.

MERCURY ASSAY. All assays included in this investigation were made by C. M. Bouton at the Berkeley station of the U. S. Bureau of Mines.⁴ The method was developed at the Berkeley station and has given general satisfaction. The difficulties of assaying these products, in which an error as small as 0.01% seriously affects the interpretation of results, will be appreciated. The method consists essentially of subliming the mercury in a glass tube contained in a heated iron block, then dissolving the quicksilver in nitric acid and titrating with a standard solution of ammonium thiocyanate; ferric salt is used as indicator.

MINING IN TEXAS during 1919 was confined largely to the production of silver. The Presidio mine, at Shafter, Texas, was in continuous operation during the year and small shipments of copper, lead, and zinc ores were made from the Van Horn and Sierra Blanca districts. The production for the State for the year was 540,000 oz. of silver and nominal quantities of gold, lead, copper, and zinc.

⁴Duschak, L. H., 'The Determination of Mercury', Tech. Paper 227, Bureau of Mines (in press).

A Contribution to the Study of Flotation—III

By H. LIVINGSTONE SULMAN

SURFACE-ENERGY AND SURFACE-TENSION OF SOLIDS

The molecular hypothesis renders the conception of surface-energy equally necessary for solids, whose surfaces must therefore be regarded as being under a tensional strain similar to that existing for liquids.

We are however at a complete loss for any method to quantify or even to estimate the surface-energy of a solid; all such measurements for liquids depend, in one form or another, upon quantifying the force required to extend their surfaces, an operation which is precluded in the case of a solid. In the present state of our knowledge, the order of surface-energy and tension is unknown for solids, though several attempts have been made to estimate its range; that it exists however, and is usually of a high value, is certain. Since the surface-energy of liquids increases with diminishing temperature, it is highly improbable that it will, or can, disappear when the liquid solidifies or freezes; although the heat liberated on solidification (latent heat of fusion) must somewhat diminish the total energy of the solid and will possibly influence the unbalanced forces at its surface. Mercury, having a surface-tension of about 441 dynes/cm. at 0°C., and a temperature coefficient of 0.379 dynes/cm. for one degree C., solidifies at -40. Hence its surface-tension on approaching the freezing-point will be $441 + (0.379 \times 40) = 456.16$ dynes; after making a deduction for the latent heat of fusion it is evident that solid mercury must yet retain high surface-energy.

Widely divergent views exist as to the probable order of solid surface-tensions. By employing a method based upon the heats of solution of large and small particles, Hulett deduced a value of 1100 dynes/cm. for calcium sulphate and 4000 dynes/cm. for barium sulphate. Although these values have been accepted by some physicists, they seem improbably high when regarded from the point of view of flotation experience. The sum of the interfacial tensions of water and barium sulphate would be 4075; but on the addition to the water of 0.02% of sodium silicate (a concentration of 1 in 5000) the barium sulphate is only so far wetted that the contact-angle between solid and liquid is practically reduced to 0°; that is, as will be shown later, the energy of the liquid/solid interface has only fallen to $4000 - 75 = 3925$ ergs per sq. cm.; an altogether inconsiderable reduction of the total assumed energy of the barium sulphate unit surface. Further, on increasing the concentration of sodium silicate to two or three times the former figure, the barium sulphate is entirely deflocculated and put into the condition of a true suspension, which implies its complete wetting, and therefore the reduction of the interfacial energy to zero. If a very small addition of sodium

silicate at first reduces the surface-energy of the solid by merely a few ergs per square centimetre, it appears unlikely that merely doubling or trebling the amount would diminish a remaining interfacial tension of several thousand ergs per square centimetre to zero; from this point of view the estimate of 4000 dynes as the surface-energy of barium sulphate appears excessive, nor does it seem to be in line with that of calcium sulphate, nor comparable with the much lower probable value for solid mercury. Such considerations indicate the unsatisfactory state of our present knowledge of surface-energy for solids.

DYNAMICAL ASPECT OF SURFACES. At the actual surface of a liquid the molecules are in violent motion in all directions. Some are therefore continually projected outward; most are pulled back into the liquid by the attractions of their neighbors in the surface-layer, but those whose velocity is greater than the average (estimated for water at three times the average velocity) will escape into the air; such molecular escapes constitute evaporation. If the liquid be contained in a closed vessel the escaped molecules after numerous collisions with each other and the walls of the vessel tend ultimately to be re-captured at the liquid surface. When the rate of molecular escape is equal to that of return, equilibrium for the liquid at the particular temperature is established. The escaped molecules exercise a definite pressure ('vapor pressure' of the liquid) on the containing walls, and the vapor so produced approximates in constitution to a gas. The surface of a quiescent liquid, though to the eye the smoothest plane, is in reality a seething mass of molecules. Even at a sufficiently lowered temperature where few or none of the molecules finally escape, the surface-layer must still exhibit incessant molecular projections, affording a further reason for the decreased density of the surface-layer. Similar conditions must also obtain at every interface, whether of liquid/liquid or liquid/solid.

Though in a solid the molecular amplitude is smaller, the surface molecules are yet in extremely rapid lateral and vertical oscillation. Very few will escape unless their velocities are sufficiently increased by heat, in which case 'sublimation' results. By reason of such molecular movements the surface of a solid also must be less dense than the interior.

The comparatively loose molecular texture of many surfaces, hitherto unsuspected, has been demonstrated by Beilby,¹ who found that by lightly rubbing copper, calcite, etc., with the finger-tip covered with chamois

¹'The Hard and Soft States in Metals'. G. T. Beilby, Institute of Metals, May 12, 1911.

leather, a surface-layer estimated at 100μ in depth, and therefore many hundreds of molecules in thickness, will flow under the friction like a fluid. The fluid layer retains its mobility for but a short period and re-solidifies into a vitreous amorphous form, differing from the original surface structure whence it was derived. The new layer is harder than the original crystalline surface and is also more soluble in acids. When completely dissolved away, furrowing effects resulting from the initial friction become visible under a high-power objective upon the exposed and unaltered layer, at a computed depth of probably more than a thousand molecules.

Lord Rayleigh² has also recorded experiments that show a similar flowage in glass surfaces during final light polishing operations. It also appears possible to rub water into glass surfaces by the pressure of the fingers; two surfaces so treated and pressed together will unite

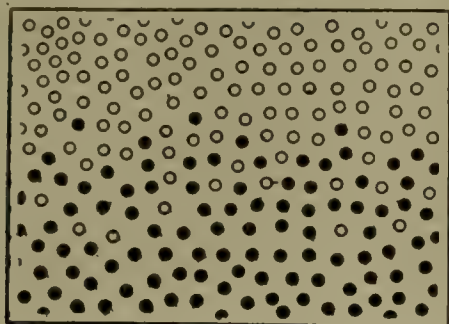


FIG. 2

with such firmness that efforts to detach them by shearing result in the disruption of the substance of the glass on one or other side of the contact.³ The similar effect of wet gelatine allowed to dry upon glass is well known.

Quartz, porcelain, and other hard surfaces are easily stained by rust to considerable depths; if a piece of iron or a ferrous salt be left for some time in contact with porcelain in presence of air and moisture, the resulting stain will penetrate so deeply as to become impossible of removal by hot acids. Roberts-Austen showed that if the accurately faced surfaces of two slabs, one of cast-iron and the other of pure iron, be left together under pressure for a long period carbon will ultimately be found through the mass of the originally pure metal.

These and other facts to be noticed later indicate that the surfaces of both sulphide minerals and gangue may undergo profound surface modification during crushing, attrition, water-treatment, etc. Taken in connection with many other facts such as the 'sweating' of oil through iron, of 'cementation', 'case-hardening', 'solid-solution', etc., and with the wide accumulation of knowledge as to the 'sorption' of gases by solids (occlusion, absorption, diffusion, and permeability), the view is strengthened that the surfaces of solids must often be

not only granular but often plastic also, and thus frequently capable of penetration by the molecules of gases, liquids, and even of other solids. Selective-wetting effects obtainable in differential flotation also indicate some degree of surface penetration to be probable. Most solid/liquid interfaces instead of being represented by a mere plane have more probably the constitution suggested in Fig. 2, where the molecules of the liquid are shown as becoming interlocked with or 'rooted' into those of the solid at the plane of contact.

An accumulation of facts shows that most minerals, even when possessing no water of crystallization, have water molecules dispersed throughout their masses; it appears probable that such act as nuclei for the condensation of other like molecules. While they remain, the mineral will be readily wetted by water; but if they are expelled by long heating in vacuum, or by high temperature, the substance is no longer capable of being wetted, for example, fused quartz. The experiments of Trouton (confirmed for quartz, blende, and galena by Edser), of Mellor, Holdcroft, and many others appear capable of no other explanation.

When an apparently dry crystal of galena is freshly crushed, and the powder carefully scattered on the surface of distilled water, a large proportion of the particles sink. After drying the powder in vacuum over P_2O_5 , or by heat, all the particles float; if, however, galena particles be left submerged in pure distilled water for some time, they partly lose their power of flotation. Freshly crushed quartz particles sink, but when dried in vacuum at high temperature they float perfectly on water, and absorb no moisture from an atmosphere saturated with water-vapor. Fused silica behaves in the same way, water standing upon its surface like drops of mercury upon glass.

Edser says, "the slowness with which this water is given off and its persistent evolution even when the mineral has been heated to $250-300^\circ C$. for several hours indicates that the water was originally distributed throughout the substance of the mineral. When once the minerals have been dried in vacuum at high temperature, moisture does not condense on their surfaces from an atmosphere saturated with aqueous vapor." In line with this, Beilby's work and Hardy's experiments with glass indicate that rubbing the solid surface with the liquid will accelerate penetration of the former by the latter.

This view of the granular and porous nature of solid surfaces now offers a rational explanation for the 'hysteresis of contact-angle' between solid and liquid surfaces, to be considered later. Also of the fact that a drop of liquid placed upon a solid surface does not 'slip' over it as a whole when the surface is tilted; the molecules of the fluid appear more or less strongly anchored in the solid, and all movement of the liquid is due to the mobility of its molecules above the plane of contact. This is confirmed by observations as to the 'skin-friction' of a ship which occurs between the film of water carried by the ship's surface and that passed through, and in the phenomena of lubrication, where the oil-film does not slip

²Trans. Optical Society, Vol. xiv, October, 1917.

³W. B. Hardy, Jour. Soc. Chem. Ind., p. 7 T, January 1919.

over the surfaces it lubricates but is sheared at an intermediate layer of its own substance.

INTERFACIAL TENSION. As the degree of adhesion between a solid and liquid determines the interfacial tension at their contact plane, a clear understanding of the term is necessary so far as the recondite nature of the occurrences permits.

Let two dissimilar substances, A and B, be in contact at a common interface, and let the molecules of A attract each other more than they attract those of B; then the molecules in a layer of A at the interface will possess more energy than the molecules in the interior of A. Similarly if the molecules of B attract each other more than they attract those of A, there will be an energized layer of B molecules at the interface. The excess energy of the joint layer at the interface will produce an interfacial tension, which among other effects resists lateral extension. The interfacial tension between two liquids can be measured in various ways; by drop-forming, by the oscillation of drops,⁴ by the method of ripples, but more satisfactorily, where possible, by weighing. Interfacial tension between solid and liquid is therefore due to the energy stored in the solid and liquid on both sides of the contact; within limits it is quantifiable by the angle of contact made between the liquid/air and solid/air surfaces.

If σ_1 be used to represent the surface-tension of the liquid phase and σ_2 that of the solid phase, σ_{12} is the accepted method for expressing the tension of the interface between them when they are in contact.

Then σ_1 = the work done in creating 1 sq. cm. of the free liquid surface

σ_2 = the work done in creating 1 sq. cm. of the solid surface

σ_{12} = the work done in creating 1 sq. cm. of the solid liquid interface.

Also let W_{12} be the work done in separating 1 sq. cm. of the interface into two fresh surfaces of 1 sq. cm. each, having energies respectively of σ_1 and σ_2 .

Let W_1 be the work done in similarly separating the liquid at a plane of unit area into two fresh liquid surfaces of energy σ_1 .

Let W_2 be the work done similarly per unit area of solid in separating it into two surfaces of energy σ_2 .

Imagine the solid and liquid surfaces to be brought together. If no work is done in again separating them the total energy of the interface (interfacial tension) will be the sum of the energies of the two surfaces:

$$\sigma_{12} = \sigma_1 + \sigma_2 \text{ when } W_{12} = 0$$

This would mean that the molecules of the liquid exert no attraction whatever across the interface upon the molecules of the solid, and vice versa, so that no

⁴If drops of an oil, lighter than water, are allowed to rise through water, they will be observed to oscillate, becoming alternately oblate and prolate spheroids; the higher the interfacial tension the more rapid the oscillation, whence by comparative methods the value may be deduced.

adhesion exists between the substances; the strain in the system is unrelieved and the interface will exhibit maximum tension.

This state is hypothetical, and no instance of complete 'non-wetting' is known; this would involve a contact-angle (written Θ) of 180° , whereas the highest known angular value for a solid/liquid contact (mercury/glass) is about 148° , though higher contact-angles occur be-

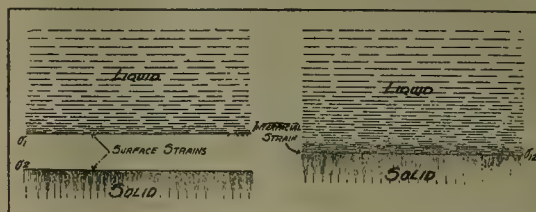


FIG. 3

tween several immiscible liquids; in every case therefore some degree of wetting, that is, adhesion, occurs.

Next let us consider the *interfacial tension in regard to the equilibrium of a bubble attached to a surface*:

The 'contact-angle' Θ is that made between the air/water and the water/solid interface. A point P will there be held in equilibrium by the algebraic sum of the three tensions: the tension of the solid, σ_2 ; the component of the tension of the liquid, σ_1 , resolved parallel to the surface, $= \sigma_1 \cos \Theta$; and the interfacial tension σ_{12} .

$$\text{Then } \sigma_2 = \sigma_1 \cos \Theta + \sigma_{12}, \therefore \frac{\sigma_2 - \sigma_{12}}{\sigma_1} = \cos \Theta.$$

If this condition is complied with the bubble (neglecting gravity as may be done when the bubble is small) will be in equilibrium and will not alter in configuration.

The above is the general expression connecting inter-

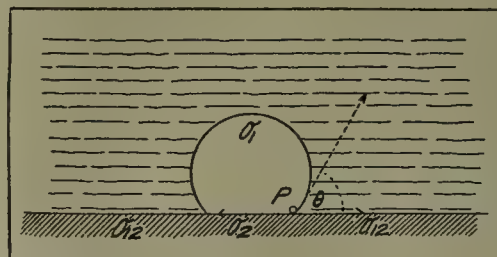


FIG. 4

facial tension with the magnitude of the contact-angle, and expresses the fact that, within certain limits considered later, the extent to which the surface tension of any given solid is reduced, by contact with the liquid at the interface between them, will determine the angle of contact between the air/liquid and liquid/solid interfaces. The amount by which the original total tensional energies of the two phases is reduced depends upon the degree of adhesion established between them. When no reduction takes place interfacial tension is maximum and adhesion *nil*; when the reduction is complete adhesion reaches the maximum and interfacial tension becomes zero.

Statistical Review

Production of Metal Mines for 1919*

Montana

The value of the gold, silver, copper, lead, and zinc mined in Montana in 1919, according to the estimate of C. N. Gerry, was more than \$66,307,000, a decrease of about \$55,098,000 from the value for 1918. All the metals but lead showed a decided decrease. On account of the low prices for copper, lead, and zinc, the mines at Butte, soon after the first of the year, reduced their output to about 60% of normal. Production from the mines was not seriously affected by strikes, although there was some labor trouble in February.

GOLD. The value of the gold output fell from \$3,104,764 in 1918 to about \$2,272,000 in 1919, a decrease of nearly 27%. The main decrease was the output of gold derived from copper ores; there were slight decreases of gold derived from iron ore, silicious ore, and from dredging.

SILVER. The mine output of silver decreased from 16,797,479 oz. in 1918 to about 13,281,000 oz. in 1919, and the value of the output decreased from \$16,797,479 to about \$14,768,000. In 1918 and 1919 Montana was the leading silver producer of the United States. In 1919, as in past years, most of this silver came from copper ores, but a large part was obtained from residues from zinc ores, both those smelted in the East and those treated in the electrolytic plant at Great Falls, Montana. The principal producers of silver were the Anaconda Copper Mining Co., Butte & Superior, Elm Orlu, North Butte, East Butte, Davis Daly, Butte Reduction Works tailing dump, and the Granite-Bimetallic mine, at Philipsburg.

COPPER. The output of copper decreased from 323,174,850 lb. in 1918 to about 180,246,000 lb. in 1919. This represents a decrease of 142,928,000 lb. in quantity and \$45,884,000 in value. The average monthly production of the smelting plants of the Anaconda Copper Co., at Great Falls and Anaconda, according to published statements, was nearly 13,000,000 lb. of copper, as against 24,500,000 lb. in 1918. The Pittsmont plant of the East Butte Co. produced more than 1,500,000 lb. per month, instead of 2,000,000 lb., as in 1918. In addition to the mines of the Anaconda and East Butte companies, the North Butte, Davis Daly, Butte Reduction Works dump, Butte Ramsdall, Elm Orlu, Butte Duluth, Butte & Superior, Tuolumne, and Bullwhacker produced considerable copper.

LEAD. The mine production of lead increased from 37,135,875 lb. in 1918 to about 42,163,000 lb. in 1919, but the value of the output decreased from \$2,636,647 to about \$2,411,737. A large part of the lead was obtained from the lead-zinc ores of the Butte district. The Snow

Storm mine, at Troy, Lincoln county, and the Angelica mine, in Jefferson county, were also notable contributors. By-products from the electrolytic zinc plant at Great Falls have added greatly to the totals of both silver and lead. The lead smelter of the American Smelting & Refining Co., at East Helena, was active on ores and concentrates, most of them shipped from Idaho and Montana.

ZINC. The output of recoverable zinc in Montana decreased from 209,258,148 lb. in 1918 to about 176,432,000 lb. in 1919. The value of the output decreased from \$19,042,491 to about \$12,915,000. The principal zinc producers of Montana were the Butte & Superior, Anaconda, Elm Orlu, and Butte Copper & Zinc mines. Smaller producers were the Snow Storm mine, in Lincoln county; the Davis Daly, at Butte; and the Montana Consolidated, in Jefferson county. Most of the zinc concentrates were smelted in the East, but zinc ore from the mines of the Anaconda Copper Mining Co. was concentrated at Anaconda and the concentrates were leached at Great Falls. The electrolytic plant was active during 1919, but the output was less than that of 1918, when much custom material was treated.

The dividends paid by Montana companies for the first eleven months of 1919 amounted to about \$10,590,600. The principal dividend payers were the Anaconda Copper Mining Co. and the Barnes King Mining Company.

Nevada

The value of the gold, silver, copper, lead, and zinc mined in Nevada in 1919 was about \$23,634,000, according to preliminary figures compiled by Victor C. Heikes. This is a decrease of over \$24,894,124, or more than 50%, from the output of 1918, when the mines produced \$48,528,124. The decrease was general, but in point of value the largest decrease was that in copper, which amounted to more than \$19,114,000.

GOLD. The gold output decreased from \$6,619,937 in 1918 to \$4,718,000 in 1919, a decrease of 29%. The Goldfield Consolidated has for several years held the record of being the largest gold producer in Nevada, but in 1919 the company ceased operations and the property was turned over to a developing company. The output of gold from the Tonopah district also decreased notably, amounting to only \$759,000, against \$1,287,745 in 1918. The Elko mine, at Jarbidge, was the largest producer of gold in the State. Other gold mines that had an output of more than \$200,000 each were the Nevada Consolidated, Fairview Round Mountain, Florence Goldfield, and Consolidated Virginia.

SILVER. The mine production of silver decreased in

*From preliminary reports of the U. S. Geological Survey.

quantity from 10,000,599 oz. in 1918 to 7,177,000 oz. in 1919 and in value from \$10,000,599 to \$7,982,000. About 3,535,000 oz. of silver was produced in the Tonopah district, where the principal contributors were the Tonopah Belmont, Tonopah Extension, Tonopah Mining, and West End mines. Large quantities of silver also were produced by the Nevada Wonder, in Churchill county, and the Rochester and Nevada Packard properties, in Pershing county. Smaller outputs were made by the Yellow Pine, Prince Consolidated, Elko Prince, and several properties at Virginia City. The Comstock district produced about 240,000 oz., and several properties at Rochester produced about 575,000 ounces.

COPPER. The mine output of copper decreased in quantity from 116,316,441 lb. in 1918 to 51,000,000 lb. in 1919, and in value from \$28,730,161 to \$9,616,000. The Nevada Consolidated, at Ely, in White Pine county, was the largest producer and contributed more than 3,500,000 lb. of copper per month; and the Consolidated Coppermines, in the same county, made a notable though greatly reduced production. The Mason Valley smelter, at Thompson, in Lyon county, was operated for only two months, and the shut-down there resulted in a decrease of more than 1,000,000 lb. of copper per month.

LEAD. The mine output of lead decreased in quantity from 23,316,534 lb. in 1918 to 12,558,000 lb. in 1919, and in value from \$1,655,474 to \$718,000. The Prince Consolidated mine, at Pioche, remained the largest lead producer of the State, and the Virginia Louise, Combined Metals, and Black Metals mines, in the same district, shipped considerable ore containing lead. In Clark county the Yellow Pine mine made a lead production second only to that of the Prince Consolidated, and the Goodsprings Anchor Mining Co. shipped a rich lead concentrate. At Eureka the Eureka Croesus and Eureka Holly companies shipped much lead ore.

ZINC. The mine output of recoverable zinc decreased in quantity from 16,724,753 lb. in 1918 to 8,182,000 lb. in 1919, and in value from \$1,521,953 to \$598,973. A large part of the output came from the Yellowpine district, in Clark county, though there was a distinct decrease from this region. The Consolidated Coppermines, in White Pine county, made large shipments of zinc ore, resulting in a production considerably greater than that of 1918.

Incomplete dividends, declared by Nevada mining companies for the first eleven months of 1919 amounted to \$3,327,188. The principal contributors were the Nevada Consolidated, Tonopah Extension, Tonopah Belmont, Tonopah Mining, West End, Nevada Wonder, Nevada Packard, and Fairview Round Mountain companies.

New Mexico

The output of the mines of New Mexico for 11 months of 1919 and the estimated output for December, as reported by Charles W. Henderson, amounted to \$568,000 in gold, 709,000 oz. of silver, 2,800,000 lb. of lead, 52,200,000 lb. of copper, and 8,000,000 lb. of zinc, as compared with \$682,791 in gold, 782,421 oz. of silver, 8,398,

239 lb. of lead, 98,264,563 lb. of copper, and 24,050,324 lb. of zinc in 1918. These preliminary figures show decreases of \$115,000 in gold, 73,000 oz. of silver, 5,600,000 lb. of lead, 46,000,000 lb. of copper, and 16,000,000 lb. of zinc. All the mines except silver mines suffered from low prices of metal, and increased prices of labor and materials.

The decrease in the output of all metals except gold and silver is startling. Mills of the Mogollon district, Socorro county, produced \$129,000 in gold and 310,000 oz. of silver as compared with \$119,710 in gold and 302,902 oz. of silver in 1918. In 1919 the Mogollon Mines Co.'s mill was operated steadily, but the Socorro Mining & Milling Co.'s mill was closed April 1, and operations were not resumed during the year. The output of gold from the Aztec mine, at Baldy, Colfax county, was not so large in 1919 as in 1918. The shipments of gold-bearing silicious copper ores from Lordsburg increased heavily, but there was a decrease in the shipments of gold-bearing iron-copper ores from Orogrande.

COPPER. Copper has long been an important metal product of New Mexico, and since operations were begun by the Chino Copper Co. at Santa Rita at the beginning of 1910, the State's output of this metal has been large. The large decrease in the output of copper in 1919 is therefore particularly impressive, for the total output is only a little more than half that in 1918. In 1919 the Chino Copper Co.'s output was 43,992,000 lb., as compared with 79,340,372 lb. in 1918. Beginning in January 1919 with an output less than the average monthly output in 1918, this company curtailed operations to about 50% of its capacity during the rest of the year. The Burro Mountain Branch of the Phelps Dodge Co., which in 1918 produced 53,146 tons of concentrate averaging 14.9% copper, was even more seriously affected by the drop in the price of copper and suspended milling operations early in the year and did not resume. The copper-matting plant at San Pedro was not in operation in 1919 and was dismantled. The 85 Mining Co., at Lordsburg, made a large increase in shipments in 1919, but shipped crude ore entirely that year, as compared with concentrate and crude ore in 1918. The copper ore shipments from Orogrande decreased heavily.

LEAD. The shipments of lead ore from New Mexico decreased heavily. Hardly any lead ore was shipped from the Organ Mountains district, and the shipments from the Central district, Grant county, and the Magdalena district, Socorro county, were less than in 1918, as were also the shipments from the less productive Cooks Peak and Victorio district, Luna county.

ZINC. The output of zinc sulphide and zinc-carbonate ores likewise decreased seriously. The Ozark mill, at Kelly, was operated only in an experimental way, and the Cleveland mill, at Pinos Altos, was operated for only a short time. The Hanover mill was not operated to its full capacity. Much less carbonate zinc ores were shipped from Hanover, Kelly, and Cooks Peak than in 1918. The Republic Co., at Hanover, shipped a considerable quantity of high-grade zinc sulphide ores.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA

DOCK PROPOSED FOR HYDER.

HYDER.—The little but bustling mining town of Hyder, situated near the Canadian border on the upper reaches of Portland canal, which has the distinction of being the gateway to the newly discovered and promising mining section of the Salmon river, is to have new docks and other facilities for the handling of freight and general

ARIZONA

BONUS-MONEY FOR PHELPS DODGE EMPLOYEES.—BISBEE NOTES.

DOUGLAS.—Approximately \$80,000 in bonus-money was distributed among employees of the Phelps Dodge Corporation and Calumet & Arizona smelting plant on the first pay day in January. At the Copper Queen branch-smelter 440 men received approximately \$52,000. During



HYDRAULICKING IN LOVETT GULCH, YUKON TERRITORY

business, according to a report from Juneau. John Sutherland, a business man of Hyder, it is announced, has filed at Juneau articles of incorporation of the Hyder Dock Co., organized to construct a \$30,000 pier. At present most of the freight billed for Hyder is handled on barges over the tide flats. The new pier will be ready for use, it is hoped, before the commencement of the rush which is expected to begin just as soon as the weather opens in the spring. Inquiry from all parts of the United States indicates that there may be a repetition on a smaller scale of the historic stampede to the Klondike in 1898. The most important mine in the Salmon River district is the Premier (or Bush) mine, developed by R. K. Neill of Spokane. At the present time ore from the Premier is being shipped through Hyder to Seattle.

1919 this smelter paid out approximately \$90,000 to a total of 760 employees. The Calumet & Arizona smelter's January bonus-payment was \$28,620 to 250 men. This smelter paid out approximately \$16,000 additional during 1919 to 150 other men. These sums were, of course, in addition to regular wages, and are in recognition of faithful continuous service. The first year's bonus for employees is \$100 and each succeeding year of service brings an increase of \$10 until the maximum payment reaches \$250. It is claimed that no smelter of similar size in the world has a greater number of men who have been continuously employed. The bonus system was adopted as a profit-sharing measure and to increase the force of permanent satisfied employees by giving a definite reward for continuity of service. That the men appreciate it

is shown by the larger number who share in its benefits each year.

A luncheon was given in honor of A. T. Thomson, assistant to the president of the Phelps Dodge Corporation, who left here during the first week in January for New York. This was made the occasion of presenting Mr. Thomson with a handsome watch and chain as a token of the esteem in which he is held by his associates.

Flags were flown at half-mast for three days on all buildings of the Phelps Dodge Corporation out of respect for James McClean, vice-president of the concern, who died on the morning of January 7. Mr. McClean first associated himself with D. Willis James and William Dodge in importing tin before the company became engaged in mining. When the old firm of Phelps, Dodge & Co. became the Phelps Dodge Corporation in 1912 he became vice-president. His property interests brought him frequently to the South-West and he was well liked and highly respected by those in this section who knew him personally.

HUMBOLDT.—The Consolidated Arizona Smelting Co. reports having produced during December from the Blue Bell and De Soto mines 13,100 tons of ore which was shipped to the reduction-plant. The concentrator handled 9200 tons of material while the smelter treated 7400 tons of new ores and concentrates. Shipments of fine copper bullion to the Eastern refinery amounted to 615,000 lb., of which 500,000 lb. was derived from company ores.

BISBEE.—The Boras lease, adjoining the White Tail Deer and the Night Hawk, near Don Luis, was reported on January 11 still to be in oxide ore averaging from 7 to 8%, in the drift it has been running from the 90-ft. winze sunk from the 400-ft. level. The drift after being advanced 34 ft. was still in ore. The main shaft of the Boras is 400 ft. deep. A drift on this level encountered a fault at the point where the winze was started. Shipments to the smelter at Douglas are being made as rapidly as the equipment of the property will allow. A new hoist of larger capacity has been ordered and should arrive from Denver before the end of the month. The Lowell Gold Mining Co., composed of a group of Warren operators, has leased its property in the Quijotoa mountains in Pima county, 80 miles from Tucson. The lease covers a period of five years with option to buy at the end of that time. Considerable development work is planned. A stamp-mill will be installed. The owning company is composed of J. L. Winters, president; Fred Henderson, vice-president; John P. Williamson and M. E. Kawn, directors.

HILL TOP.—The Hill Top Metals Mining Co. is working a force of 40 men at its silver-lead mine. Driving of the lower tunnel has given way temporarily to cross-cutting, and in the upper tunnels drifts are following the ore in several places, according to R. O. Fife, managing director. J. O. Fife, president of the company, arrived from his headquarters in Kansas City, January 15, to inspect recent work. C. O. Botsford and W. G. Rice, who control the Manhattan, a copper property,

situated near Hill Top, recently inspected it and it is anticipated that they will install machinery soon and re-open the property.

MIAMI.—F. W. MacLennan, general manager for the Miami Commercial Co., has rendered a report to all employees of the Miami Copper Co., Miami Commercial Co., and Miami-Inspiration hospital that as a result of operating the store of the Commercial company on a co-operative basis during November and December a net profit of \$7492 was realized to be distributed in the form of rebates to the employees of the companies named. This amounts to a rebate of 13.9%.

TOMBSTONE.—A new profitable venture, the working of old mine dumps for the silver and lead content, discarded in the 'boom' days of the district, has been started and before long it is believed that several operations of this character will be under way. Al Godfrey and Bert Holland were the pioneers in the field, having recently completed a small concentrator near the Emerald mine, purposing to treat the large dump. The first runs gave excellent recovery and a good profit for the lessees. The concentrator has been built at the foot of the dump and an automatic feed provided to carry the screenings onto the table. This does away with handling from the time it enters the car to be dumped on the screens until the concentrate is sacked for shipment. A gasoline engine runs the whole plant. There are thousands of tons of workable material on the dump which will require a considerable period to treat. Several other dumps in the district await similar handling. There are approximately 100 leases being operated in the district at present and from 75 to 80 carloads of ore are shipped monthly.

COLORADO

CRIPPLE CREEK DIVIDENDS.—LESSEES ACTIVE AT LEADVILLE.

CRIPPLE CREEK.—Dividends for January to be paid by mining and milling companies in Cripple Creek total \$160,000 as follows: Portland Gold Mining Co. 2c., \$60,000; Golden Cycle Mining & Reduction Co. 3c., \$45,000; United Gold Mines Co. 1c., \$40,000; Vindicator Consolidated Gold Mining Co., 1c., \$15,000. The rich sulphide ore opened up at the twenty-third level of the Portland No. 2 shaft, is said by the mine officials to be the richest discovery made in years at this Battle Mountain property. Precautions have been taken to prevent high-grad-ing, as quartz from the core of the vein, containing crystals of calaverite, is worth many dollars per pound. Miners are required to use the change room and change even their shoes before leaving the property for their homes.

Ore assaying about 1½ oz. gold and 12 to 15 oz. silver per ton has been opened up on the 1200-ft. level of the Blue Flag by the War Eagle Consolidated company. The Blue Flag company is driving to connect with the Moffat or Ophelia tunnel, and thence through the War Eagle property to a point under the Scott or main shaft. Work in the Blue Flag lateral is done under air-pressure on account of the presence of mine-gases, and except for the

ore taken out in drifting no attention will be paid to mining until the connections are completed. Tulley Scott, judge of the Colorado Supreme Court, is president of the War Eagle company. Operations have been suspended in the Gold Coin workings of the Granite Gold Mining Co. in Victor, and the company and some 15 sets of lessees are operating through the Dillon shaft on Battle mountain. Production for January will approximate 1000 tons of ore, ranging in value from \$10 to \$60 per ton. The Granite company is also operating the Bonanza fraction of the United Gold Mines Co. through the Dillon, and is shipping about 100 tons per month of ore containing from two to three ounces of gold.

Daily shipments of good ore are leaving the Modoc Consolidated company's No. 2 or Last Dollar shaft on Bull hill at the rate of 50 tons daily. The Cresson continues

ily and shipments are going to the smelter at the rate of 15 tons per day. The same people are also operating the Griffin property in the St. Kevin district where silver ore assaying between 30 and 50 oz. is being shipped.

The Northern mine at the head of Ninth street is to resume operations. The mine, when closed down about three months ago, was producing a rich silver-chloride ore. Lessees on the Dinero in the Sugar Loaf locality are mining high-grade silver ore and shipping a fair tonnage of smelting ore. Operations have been resumed on the old Matchless mine by A. B. Bailey, representing an Eastern syndicate. It is planned to sink the shaft and carry on deep development. Two sets of lessees at the Dunkin No. 3 and 4 shafts are shipping iron ore to the smelter at the rate of several hundred tons per month.

Consolidations of mining properties situated in the



THE CRESSON MINE, CRIPPLE CREEK, COLORADO

heavy production and with the grade holding up the treasury reserve is again gaining. No dividend was declared for January, but a payment is expected before the first quarter of 1920 closes.

LEADVILLE.—The metal output of the Leadville district for the past year totaled \$6,543,077, with zinc, the chief product, amounting to \$2,466,931. Silver produced was valued at \$2,042,226; lead, \$812,005; gold, \$719,999; copper, \$249,416; manganese, \$245,000; and bismuth, \$7500.

The Fanny Rawlins Gold Mining Co., owning the Fanny Rawlins mine on Breece hill, operated under lease, has resumed payment of dividends with the distribution on February 16 of \$5000. The dividend of $\frac{1}{2}$ ¢ per share is made payable to stockholders of record on January 31. J. A. Himebaugh, president, in his report showed \$13,307 on hand in addition to ore in transit or at the smelter. Recent shipments totaling 391 tons have averaged better than \$40 per ton. The last previous dividend was paid in December 1908. The Long and Derry mine in Iowa gulch, under lease to H. Schraeder, is producing stead-

Graham Park section west of the Iron fault and extending to the Iron-Silver properties are said to be pending. Experimental work is in progress at the plant of the Colorado Concentrating Co., with a new process for concentrating the sulphide ores of low grade. If the experiments are successful a magnetic-separating plant will be constructed.

MICHIGAN

PLANS AT SENECA.—DECEMBER PRODUCTION.

Houghton.—Seneca has completed the south drift on the second level while the north drift has 115 ft. to go before reaching the limits. The third-level laterals will be under way this week. The third-level drift on the vein will run 250 ft. to reach the south limits of the property, but the north drift will run without regard to property limitations. From a mining standpoint the next important thing is to sink the Gratiot shaft to greater depth and then connect up with a lower level of the Seneca. This will have to be done sooner or later to provide the

Seneca with proper ventilation to make mining conditions efficient. The Seneca has to have a permanent hoisting and compressor-plant and ore-house before it can produce on a large scale. The present hoist, which was in use in this district 35 years ago, is doing efficient service but it was designed to use for hoisting-operations down to the sixth level only.

The Seneca stockpile contains 7000 tons of good Kearsarge amygdaloid ore which is being shipped in train-loads of 700 tons. This is enough ore to keep one section at the Baltic mill operating two shifts. The ore-bins and chutes at the shaft have been arranged to dump the ore that is hoisted directly into railway cars.

The Champion mine of the Copper Range company, owned jointly by the St. Mary's Mineral Land Co. and the Copper Range, has the best record of any of the copper mines of the Lake Superior district for the month of December. The production of refined copper totals 1,840,000 lb. This compares with 1,480,000 lb. in November and 1,640,000 lb. in October. The mine continues to maintain its standing as the highest-grade producer, the ore averaging 40 lb. of copper per ton for the month of December. The production of the Champion mine for the year 1919, when officially given out, will show a higher total than generally believed on account of the high copper content which will average 42 lb. for the year. The Baltic mine produced 14,000 tons of ore in December, a decrease of 3400 tons from the month before. The refined output of the mine for December will therefore show 490,000 lb. compared with 626,400 lb. in November, and 697,000 lb. in October.

MONTANA

ANACONDA COMPANY STARTS PRODUCTION AT ADDITIONAL MINES.

BUTTE.—The Butte & Superior, acting for Hayden, Stone & Co., is pushing the development work in the south section of the Butte district. The Mary Louise shaft is being repaired and equipped with machinery preparatory to an extensive exploration. This shaft is south-east of the Emma mine of the Butte Copper & Zinc, which is being prospected by the Anaconda Copper company. The latter will develop some of the veins that pass through the Emma into the Mary Louise claim. A body of ore has been struck on the east side of the Emma property which assays 8 oz. in silver, 15% zinc, and 7% lead. It is stated that the orebody is 12 ft. wide on the 1200-ft. level, but has not been opened to any extent as yet. The Emma is south and west of the Davis-Daly company's Colorado shaft and north-west of the ground being opened by the Hayden-Stone interests.

The Anaconda Copper Co. is now hiring all available experienced men at the Belmont, High Ore, Mt. View, Moonlight, and Poulin mines preparatory to the resumption of active mining in these properties. At least two thousand men will be required when working at full capacity. This will mean that the Anaconda company's operations will be at approximately 80% of normal.

The Butte & Superior produced in December 14,000,000 lb. of zinc and 215,000 oz. of silver as compared with 11,500,000 lb. of zinc and 200,000 oz. of silver in November. The East Butte Copper Co. in December produced 1,845,540 lb. of copper and 71,421 oz. of silver as compared with 1,902,580 lb. of copper and 56,834 oz. of silver during the previous month, a decrease of 57,040 lb. of copper and an increase of 14,587 oz. of silver. The North Butte has been compelled to lay off two of the three shifts at its BIRTHA mine because the leaching plant at Anaconda can handle the output of one shift only for the present.

The Argyle Silver Mining Co. will be operating in the Vipond district in Beaverhead county soon, as J. Benton Leggat has arrived at Butte from Salt Lake, and will at once prepare to open the property, which has not been worked since the early 'eighties. These claims are situated twelve miles south-west of Divide on the Oregon Short Line railroad.

General conditions are picking up in Butte, but are far from normal. This is the hardest winter ever experienced in Butte, because of the curtailed operation of the mines, which, with the severe weather and the coal strike, left at least 3000 families practically destitute; but indications are good for a prosperous year in 1920.

NEVADA

INGALLS PROPERTY IN TULE CANYON FINANCED.—ARROW-HEAD DEVELOPMENT.

TULE CANYON.—The Ingalls mine and the adjoining Jaeggars group of six claims have been optioned to Eastern capitalists for \$145,000, the first payment of \$13,000 to be made on February 12, with the others extending over a period of two years. The price for the Ingalls is \$125,000 and \$20,000 for the Jaeggars. The Ingalls has been worked for over 30 years and has a production record conservatively estimated at \$200,000. Lessees have produced \$30,000 gross during the past three years and the output from April 1 to October 1 of last year was \$15,000 gross. The average content of several lots was from 10 to 15% lead, \$5 in gold, and 30 oz. in silver. The Jaeggars claims are on the strike of the Ingalls vein. The option stipulates that 100 shifts per month shall be worked in the Ingalls and 60 in the Jaeggars. In 1914 the Ingalls was open for location, but Sheriff Ingalls of Esmeralda county did not consider it worth while to do the assessment work because of the low price of silver. W. B. Mercer of Goldfield re-located the claims for Ingalls and in this way received a half interest. The work proposed by the holders of the option will be the first on a large scale ever done in the district.

DIVIDE.—One foot of ore assaying \$57 has been opened in the west drift on the 200-ft. level of the Victory. This is the best width of good-grade ore that has been found in the Victory, which is east of the Belcher and on the same vein-system. The west drift is 214 ft. long. A report submitted by A. I. D'Arcy, general manager, at the annual stockholders' meeting, held in Goldfield on January

13, shows that 742 ft. of lateral work has been done on the 200-ft. level of the 220-ft. shaft. All lateral work has been done at this depth. The west drift is being driven in the main vein of the district and a drift also has been extended a short distance east in this vein. The company has \$45,097 cash in bank. A station is being cut at the bottom of the 100-ft. shaft of the Pay and cross-cuts are to be driven north and south to cut veins entering the Pay from the Belcher Ex. and Revert. Sinking of a shaft has been started by lessees on the Beats All claim at a point where rich silver-gold ore was found. Control of the Butte, south of the Belcher, has passed to New York and Boston interests and work is to be resumed through the 150-ft. shaft. No work has been done for several months in a number of prospects in the district.

WEST DIVIDE.—Zeb Kendall, known for his connection

ARROWHEAD.—A raise from the 175-ft. level of the Arrowhead has broken through to the 100-ft. level after continuing in ore from a point 45 ft. above the lower level. The south-east drift on the 100-ft. level has been connected with the raise. Assays taken in the raise give average returns of from \$65 to \$70.

UTAH

BINGHAM PRODUCTION.—DIVIDENDS DECLARED BY EUREKA COMPANIES.

BINGHAM.—During 1919 the mines in this district produced a total of 5,913,000 tons of ore, as compared with 13,607,650 tons in 1918. The metal output for the period is estimated at 56,000 oz. of gold, 1,600,000 oz. of silver, 117,000,000 lb. of copper, 54,000,000 lb. of lead, and



ARROWHEAD MINE, NYE COUNTY, NEVADA. MALPAIS MOUNTAIN IN LEFT BACKGROUND

with Divide companies and other mining enterprises in Nevada, is reported to have taken over a large block of stock in the West Divide. This will furnish funds for the purchase of machinery and for development work on a larger scale than heretofore. Julius Goldsmith, president of the Dividend in the Divide district, has become interested in the Silverado, east of the West Divide and on a different vein-system, and it is reported that work is to be started by this company.

GOLDFIELD.—The south-east cross-cut on the seventh level of the Florence is 450 ft. long and the west cross-cut is 650 ft. long. Recent progress to the south-east has been slow because of the necessity for timbering. The west cross-cut is nearing the Columbia Mountain fault and a change in formation is expected soon. The Red Hill has levied assessment No. 5 at the rate of 1½c. per share, payable immediately. The delinquent date is February 10. Little work has been done in the Cracker Jack recently because of trouble with the compressor.

PIONEER.—Assessment No. 4 at the rate of 1c. per share has been levied by the Consolidated Mayflower Mines Co. The assessment is payable immediately and the delinquent date is February 1. The report states that the mill has been unable to operate at capacity because of a water shortage. The spring now in use is to be further developed, according to the report.

2,674,00 lb. of recoverable zinc. The heavy decrease in shipments was due to the drastic curtailment in operations at the Utah Copper mine, which was in force throughout the year; the production from this property averaging 9,000,000 lb. of copper per month, as compared with an average of 16,500,000 lb. per month for 1918. The Ohio Copper Co. suspended operations at its mine and mill about April 1, and did not resume during the year.

PARK CITY.—Remarkably rich silver-chloride ore was recently found on the Union Tunnel level of the old portion of the Ontario mine, according to Richard Pelton, superintendent. This vein, which was cut at a depth of 500 ft. below the surface, is from 12 to 18 in. wide. According to Mr. Pelton, the ore assayed from 200 to 400 oz. silver per ton. Recently a shipment of 75 tons was sent to a Salt Lake valley smelter, which averages about 40% lead and 300 oz. silver per ton. This ore is of higher grade than any shipment made from Park City in years. An attempt to recover the rich and extensive ore-shoots, which were found in the Ontario vein, will be made on the east side, where the veins were lost because of the great Ontario fault. All searches on the other side of this fault hitherto have been unsuccessful.

Preliminary operations have succeeded so satisfactorily at the Keystone mine that breaking of ore in three or

four known faces should be started about February 1. By an agreement with the Judge M. & S. company, the Keystone has acquired the right to open up its property through the Anchor tunnel, which had been extended to within 168 ft. of the south side-line of the Keystone at the time work was stopped. It is probable that this entrance into the Keystone property, which gives a depth of 1600 ft., will be used later, when the various veins have been developed and their trend determined by exploration work from the Hanauer tunnel-level above.

Shipments of ore for the week ending January 10 totaled 2292 tons, of which Ontario shipped 850; Silver King Coalition, 549; Judge M. & S., 575; Daly West, 213; and Daly Mining, 105. During 1919, the mines produced a total of 81,457 tons of ore, of which amount Silver King leads with 22,692 tons; followed by Judge M. & S. company with 22,215 tons; Ontario Silver, 21,329 tons; Daly West, 5723 tons; Daly Mining, 3474 tons; Naildriver, 2579 tons; and Silver King Consolidated, 1260 tons. Shipments during December were the heaviest of the year, while the second largest month was January. During June the Naildriver was the only shipper, all other properties being closed down completely, owing to a strike of miners. From the best information available, the value of the gold production in 1919 was \$64,083; while the output of silver totaled 1,800,000 oz.; copper, 625,000 lb.; lead, 20,000,000 lb., and recoverable zinc, 1,350,000 pounds.

James B. Allen, manager of the Glenallen property, reports that within the next thirty days the machinery for the mill will be on the ground, and early summer will see both the mine and mill in full operation.

EUREKA.—The Iron King officials have decided to sink another shaft in the south-western part of the company's large tract in the eastern part of the district for the purpose of developing a promising section of ground which is 2500 ft. from the present workings. The management decided to sink this second shaft rather than drive a long drift, as the gas and heat would be a serious handicap.

Shipments from this district for the week ending January 10 totaled 147 cars, being a slight increase over the previous week's shipments. Mines and carloads as follows: Chief Consolidated, 42; Tintic Standard, 33; Dragon, 11; Iron Blossom, 11; Eagle & Blue Bell, 8; Centennial-Eureka, 8; Gemini, 7; Colorado, 6; Swansea, 4; Mammoth, 3; Grand Central, 3; Sioux Con., 2; Sunbeam, 2; Empire, 2; Ridge & Valley, 2; Bullion Beck, 1; Victoria, 1; Martha Washington, 1.

During the past week, the drift from the new shaft of the Yankee Consolidated cut into very promising quartz, which shows silver and gold on the 1500-ft. level. All of the ore which the mine has shipped has been taken from upper workings, and naturally a great deal of importance is attached to this new work at depth.

D. D. Muir, Jr., mine manager for the United States Mining Co., recently announced that the company would permit leasing on all levels down to the 700, and that the highest royalty the company would charge would be 50%. From this figure it will run down to as low as 15%, de-

pending on the grade of the ore. Most of the local mines that give leases require a higher royalty on high-grade ore. After being without an iron-ore contract for some time, arrangements have been made whereby the Dragon Consolidated company will ship about 60 tons of iron per day to the United States smelter at Midvale, to be used for fluxing purposes. The Dragon has many thousand tons of this ore blocked out, and the contract will add something to the earnings of the property. Directors have declared a dividend of 1c. per share, totaling \$18,750, payable January 26.

Arrangements have been made whereby two headings on the 2200-ft. level of the Iron Blossom mine will be turned over to Walter Fitch, Jr., local contractor, who will take the work up immediately. One of the Iron Blossom drifts is being driven toward the east and the other is cutting a promising section of ground to the north of the shaft. Directors of the Iron Blossom company met at Provo on January 10 and declared a dividend of 2½c. per share, totaling \$25,000.

MILFORD.—Stockholders of the Leonora Mining & Milling Co., at a recent meeting, elected the following board of directors: John Matson, C. D. Brown, J. W. Chase, L. H. Stohrs, and B. H. Goddard. At the same time the capitalization of the company was increased by 300,000 shares, all of which was deposited in the treasury.

WISCONSIN

EXPANSION OF OPERATIONS.—NEW MILLING PLANTS UNDER CONSTRUCTION.

HIGHLAND.—The Mineral Point Zinc Co., operating several mines producing carbonate-zinc ore, is reverting to old-fashioned methods of milling by building several log-washers for cleaning mine-run ore. A battery of log-washers it is claimed will recover as much marketable product as a modern concentrator and much more economically.

LINDEN.—Two new zinc-ore shippers are the Mackay Mining Co., which has taken over the Ross property, and the Fearless Mining Co., which has opened up the ground formerly mined by the Optimo company and has started a new 100-ton mill from which it is shipping concentrate assaying more than 50% zinc.

LIVINGSTON.—The New Jersey Zinc Co. has developed a new mine on the Cushman-Rewey land known as the Coker No. 2, where a mining plant is being built. The Vinegar Hill Zinc Co. has increased its output of zinc ore considerably by the addition of a new 200-ton mill on the Dale mine, operating in conjunction with a larger mill on the Yewdall land. Three distinct veins run parallel to each other, converging at a point west of the Dale mill. West of the Yewdall another mine is being opened up, giving the Vinegar Hill company territory nearly one mile in length. Other producers in the camp that are making ready to resume mining and milling after a shut-down of nearly a year are the Grunow, Lucky-Six, Peacock, New Phoenix, Biddick, Squirrel, and Big Tom mines. Shovelers are in great demand at all points in the district and earn from \$6 to \$8 per shift.

PLATTEVILLE.—The Black-House Mining Co. is engaged in constructing a new 150-ton mill east of the mine, on the Goke property. The ground has been proved with drills, eastward, giving new mining territory over two sections of land. Engineers are now engaged in proving lands east of Cuba City, 14 miles south-east of Platteville, and have taken over the Rowe property, in Shullsburg, where new mining and milling machinery is planned. The Wisconsin Zinc Co. is engaged with drills on a big stretch of land north of the city of Platteville. The site was known in former years for surface-lead and it is believed big deposits will be opened by the Wisconsin company. Nearly all of the large operating concerns represented in the field are extensively engaged in campaigns of expansion. Scores of drills are at work and rich discoveries are frequent. The impression prevails that the next three years will mark extremely prosperous conditions in the industrial life of the country and that a big demand for metals will result.

BRITISH COLUMBIA

REPORTS OF PORTLAND CANAL REGION.—CANADIAN COINAGE-LAW CHANGED.

Six of the most capable members of the Geological Survey Branch of the Department of Mines are to leave the service to accept employment with the British oil firm of S. Pearson & Son, Limited, whose headquarters are in London but who operate oil properties all over the world. Those who are going are L. D. Burling, A. O. Haynes, J. J. O'Neill, W. J. Wright, B. R. McKay, and Bruce Rose, most of whom are known for their geological work in British Columbia.

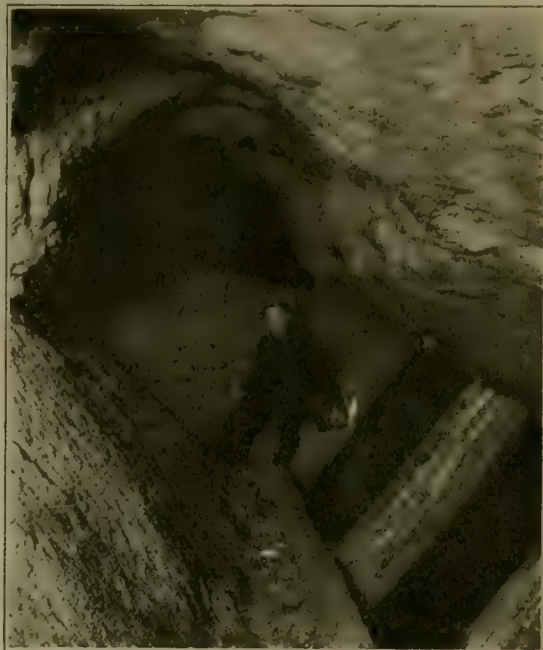
ALICE ARM.—A new townsite at Alice Arm is being planned to replace that now in use which is situated on a mudflat. The survey of the new site now is under way. It is on the side-hill north-west of the present townsite and belongs to the Alice Arm Development Co. Sufficient water is said to be convenient and the installation of other public utilities will not be difficult. In view of the mining development now in progress the enterprise seems warranted.

STEWART.—Grant Mahood accompanied the first winter shipment of 300 tons of ore from the Premier mine to Victoria. Hauling to the coast by tractor was tried, but had to be abandoned and horse transport substituted. Mr. Mahood reports favorable development at the '49 mine, where ten or twelve men are working with satisfactory results. He states that considerable interest is being taken in work in progress on the Lakeview mine, situated on the Bear River side of the Portland canal. This property was taken over last fall under bond by P. Welch and associates.

S. G. Benson, owner of the White Mouse group of mineral claims, situated about two miles beyond the '49, has placed the property in the hands of a syndicate which will start active development as soon as it is possible to haul supplies over the snow crust. Richard Elliott is at the head of the syndicate. He has had considerable mining experience, having been heavily interested in Bear

River properties at the time of the excitement about nine years ago. Mr. Benson states that the White Mouse has promising surface showings. The Sunset group is another Salmon River property on which development will commence as soon as conditions permit. A Vancouver syndicate is furnishing the necessary finances. The Salmon River Mother Lode Mining Co., Ltd., has been incorporated with an authorized capital of \$100,000 and with its head office at Vancouver.

GRAND FORKS.—A contract has been awarded for the driving of about 1000 ft. of tunneling on the Little Bertha-Pathfinder claims, 12 miles north of Grand Forks.



A STOPE IN THE BLUE BELL MINE, AINSWORTH DIVISION, BRITISH COLUMBIA

This property is an amalgamation of the companies owning the Little Bertha and the Pathfinder properties, which adjoin. Years ago each property marketed considerable high-grade silver ore, the last shipments of which went to the Greenwood smelter in 1917.

FORT STEELE.—It is reported that the building of a concentrator at the Victor property on Maus creek, is about completed. This property has been under development by R. Abernethy, of Spokane, and associates. The ore is complex, containing argentiferous galena and zinc-blende associated with iron pyrite in a quartz gangue.

VANCOUVER.—Mining men are interested in a recent announcement from Ottawa to the effect that the silver content in Canadian silver coin has been reduced, an order having been passed that on and after January 1, 1920, coins shall contain 800 parts of fine silver and 200 of alloy. Sir Henry Drayton, Minister of Finance, states that this will bring Canadian coinage to the same level as that of many other countries and will discourage melting of silver coins for the sale of the metal.

ONTARIO

DOME MINES DOING WELL.—DECEMBER OUTPUT AT NIPISSING.

PORCUPINE.—The Dome Mines has considerably increased its working force and has now about 350 men on the payroll. The mill is treating 950 tons of ore daily. The annual meeting in March is anticipated with considerable interest, as the important question of whether the company will exercise its option on the Dome Extension will be decided. Much depends on the result of diamond-drill operations now being undertaken to ascertain the downward continuation of the large orebody now being opened up on the 600-ft. level, which is said to be 100 ft. wide at one place with ore estimated to average \$5 per ton. Should the diamond-drilling from the 600-ft. level show that the orebody continues down to the 1150-ft. level a large tonnage will be proved. An important find has been made at the Davidson Consolidated, where a deposit of high-grade ore stated to be 32 ft. wide has been cut in drifting on the 500-ft. level. Another orebody has been found on the 550-ft. level. The shaft on the Clifton is down 200 ft. and some good ore has been developed.

KIRKLAND LAKE.—The Wright-Hargreaves, which will resume operations in the spring, is transporting mill-machinery to the mine which will be installed as soon as the weather permits. The Teck Hughes mill is in steady operation treating about 80 tons per day. The Lake Shore has been completely unwatered and production is now normal. The Kirkland Combine, controlled by Chicago interests, has sunk a shaft to 75 ft. which will be continued to 200 ft. before a station will be cut. The vein continues good to the point reached.

LARDER LAKE.—At the Associated Gold Fields results from sampling and diamond-drilling tend to confirm the development of a good tonnage of ore. Operations are being actively carried on by a large force and the company has funds on hand to the amount of \$825,000. The deposit on the Harris Maxwell property, known as Block B, is stated to be 300 ft. wide. It has been cross-cut in four places on the 500-ft. level and is being explored at the 400-ft. level. The ore will be blocked out in 75-ft. sections. Two wide ore-shoots have been opened up together with a number of smaller ones in the 300-ft. dolomite formation. While it is hoped that the whole body will yield commercial ore, the policy in the meantime is to develop the two main shoots. The deposit on the Reddick and Kerr-Addison properties, which is 500 ft. wide, has been cross-cut in two places 1000 ft. apart, on the first level. Exploration by means of extensive diamond-drilling and underground work are stated to have proved-up this deposit for a distance of nearly a mile.

COBALT.—During December the Nipissing mine produced \$423,139, as compared with \$350,209 in November and \$375,247 in October, thus making a total of \$1,148,595 for the last quarter of 1919. This is the highest quarterly record for Nipissing. With costs averaging 40c. per ounce and with silver selling at \$1.30 the net profits amount to more than two-thirds of the value pro-

duced. Current net profits, therefore, are now at the rate of over \$3,000,000 annually, or more than 50% of the company's issued capital. During December the Kerr Lake mine produced 106,000 oz. of silver, the net value of which is estimated at \$150,000.

The McKinley-Darragh will endeavor to keep its oil-flotation plant operating all winter. It has been found that the pumps operate successfully through weather registering 30° below zero, and that the only danger lies in the possibility of an interruption in operation.

The Beaver Consolidated, in addition to meeting with renewed success in the development of its silver mine at Cobalt, is gradually strengthening its position through developing the Kirkland Lake Gold mines in which it holds close to 90% of the stock. The Beaver is realizing some \$2000 per day net profit on its Cobalt operation, while the mill of its Kirkland Lake mine is now operating at full capacity of 150 tons per day and yielding a substantial profit. Underground developments at the Kirkland Lake have recently been favorable, a shoot having been opened up in which a considerable quantity of ore is worth \$30 per ton.

SONORA

EXPORTS OF ORE.—NORTH TIGRE LEASING CO. IS ACTIVE.

AGUA PRIETA.—While bad weather has interfered materially with ore-shipments during the middle period of the month, it is believed that the value of export will be about the same as during December, despite the decreased tonnage. Some exceptionally rich ore is to be shipped. Las Chispas, which recently made a bonanza-strike on the 600-ft. level, sent out a carload of high-grade ore that assayed exceptionally well in silver. Eight small boxes, weighing about 140 lb. each, are said to have totaled approximately \$32,000. Three other cars of high-grade ore and concentrates passed through en route to the United States on the same day, and it was stated that the total shipment amounted to more than \$180,000.

EL TIGRE.—The North Tigre Leasing Co., operating the North Tigre mine, withdrew its low-priced stock from the market January 20 and it was announced that it will not be necessary to sell any more stock at present. The company now is amply financed and has a sufficient treasury reserve to ensure operation until returns from shipments are realized. A 50-ton mill, designed by Joseph Englent of Bisbee, which is intended to be the first unit of the plant, is expected to be in operation by February 15. It uses flotation in conjunction with wet-concentration and is expected to turn out 10 tons of concentrate per day, valued at not less than \$300 per ton, when in full operation. Electric power for mill and mine work is obtained from the power-line from the Copper Queen smelter at Douglas. Engineers' estimates are that more than 40,000 tons of ore has been blocked out in the mine, shown by assays to contain approximately 1,400,000 oz. of silver, besides copper and gold. Frank J. Holmes, manager, now is engaged in breaking down a supply of ore for the mill and in getting the mine workings in good condition.



ARIZONA

Patagonia.—Cross-cutting on the 260-ft. level of the Flux mine has opened up ore running \$30 per ton in silver and copper, at a point 300 ft. south of where it is expected to find the downward extension of the Glory Hole orebody. The cross-cut lacks 25 ft. of reaching the west contact. F. B. Kolberg is manager.

Tucson.—The Ohio Arizona Copper Co. situated in the Silverbell mountains has installed a tram-line from the mine to the road where loading-bins are to be constructed. Recent development has blocked out a large body of ore and shipments are to be commenced in the near future.—The Daily Arizona Copper Co. is now conducting tests preparatory to the installation of a flotation plant to treat the ore that has been blocked out by 2000 ft. of recent development work. A road is being built from the mine in the Santa Catalina mountains to Oracle 35 miles north of Tucson.

CALIFORNIA

Amador County.—Production at the Kennedy mine has been reduced as the result of a cave on the 4000-ft. level. A block of excellent ore 100 ft. long and three sets wide was being mined too rapidly, with the result that filling was neglected and the cave resulted.—Thirty stamps of the Central Eureka at Sutter Creek are dropping on ore from the 3300, 3500, and 3700-ft. levels. New ground is being opened. A small dividend was declared in December.—Sinking continues at the Old Eureka and ore of fair grade has been uncovered in old levels, but no attempt will be made at this time to extract it.

Grass Valley.—The Idaho-Maryland Co. has 80 men on its payroll and is reported to be preparing to prospect ground above the 500-ft. level. Arrangements are also being made to unwater the mine to a depth of 1000 ft.—New buildings have been constructed at the Central Consolidated, under the management of Paul W. Smith. Preparations are being completed for installation of hoisting and pumping equipment. John H. Nichol, general manager, states that a new process will be used in recovering gold from the refractory ores.

Nevada County.—The 5-stamp mill, compressor, blacksmith shop, and other equipment on the Gold Canyon mine near Moore's Flat was recently destroyed by fire, entailing a loss of \$10,000. The property belongs to Mrs. F. Hill of San Francisco.

Sierra County.—The Tightner company at Alleghany has picked up the Star vein in a drift off the main tunnel.—A tunnel is being run by the Bessler brothers on their claim at the edge of the Downieville townsite for prospecting purposes.

COLORADO

Mayday.—The Jumbo Mining Co. is reported to have opened up a 5-ft. vein, the ore from which assays 25 oz. silver per ton. Two pack-trains are transporting the ore to the Mayday spur for shipment to the Durango smelter.

Ourray.—Luna and Eckman, lessees on the Wedge mines, have discovered a vein of high-grade silver ore, assaying

200 oz. per ton. At present prices the operators received good returns.

San Juan County.—The Gnome Mining Co., operating the Columbus mine, has opened a new body of lead-zinc ore which is said to be the most important strike in that section for years. The vein, where it has just been intersected by a cross-cut tunnel 1500 ft. long, shows a width of 30 ft. of ore, which will average \$20 per ton. The vein also carries several heavy streaks of solid mineral which will run well in silver and gold, the two amounting to \$75 per ton. The cross-cut tunnel intersects the vein at a vertical depth of more than 700 ft. below the outcrop and thus furnishes a large territory from which to extract ore. Arthur W. Johnston is manager.

Silverton.—A find of good ore in Tunnel No. 4 is reported by the Gold King Extension Mines Co. W. Z. Kinney now has a strong financial backing, and if the present run of ore continues, the operations will no doubt be resumed upon a large scale. At the present time the mill is running one shift.—The Dives Leasing Co. is breaking some good silver ore in the Old Shenadoah. The snow conditions interfere with the packing of the ore to the railroad, so that the ore is being stored for later shipment.—The Southwestern Mining Co. is working a force of 35 men on the Iowa-Tiger.

Telluride.—The Black Bear shaft is now down 300 ft. below No. 5 level. Drifting operations are under way from the bottom of the shaft, and also from No. 6 level, to intersect the vein at these depths.—The Tomboy Gold Mines Co., Ltd., is now operating the new mill treating 700 tons of ore daily. With the new process, there is a more satisfactory recovery of copper.—The Smuggler Union Mining Co. is now shipping heavily.

IDAHO

Clearwater.—The South Fork Mining & Milling Co., owning the South Fork mine in the locality of Ten Mile, has sold a block of treasury stock to Eastern capitalists for \$160,000 and will begin the erection of a mill in the spring, according to report.

Coeur d'Alene.—Fire destroyed the Bunker Hill & Sullivan North mill, or experimental plant, situated on the tailing dump immediately north of the East concentrator, on January 8. The mill is a total loss amounting to about \$95,000, partly covered by insurance.—The Amy Mining, Milling & Development Co. is cross-cutting from the bottom of a 200-ft. shaft to tap a vein that yielded ore on the tunnel level, according to M. J. Schermerhorn, a director of the company. The orebody is three feet wide on the tunnel level and the clean ore contains 60% lead and 12 oz. of silver per ton, according to the returns on three shipments.

Elmore County.—The Treasure Mines Co. has cut the first vein in its deep tunnel and is proceeding toward the second, which should be reached in March. In the upper workings of the mine ore blocked out has a value of \$200,000. The value is in gold and the ore mills freely.

Wallace.—The Consolidated Interstate-Callahan company shipped 3900 tons of zinc ore and 1100 tons of lead ore in

December. The zinc shipments were 1,800,000 lb. higher in December than in November. The grade of zinc concentrate is averaging more than 50%. The lead concentrate contains about 60% lead and 2 oz. of silver per ton.

NEVADA

Austin.—The Nevada Birch Creek Co. reports that the Cahill lode has been intersected in the upper tunnel. The drift is said to be in a full face of shipping ore. From the dip of the vein it is believed the lower tunnel will pick up the orebody 125 ft. from present working face. This tunnel is in about 500 ft. J. T. Ingram is manager.—The 1500-ft. drift from the 200-ft. level of the Austin-Dakota has intersected a shoot of ore said to assay from \$150 to \$500 in silver and gold.—The International Victory Co. is about to purchase a hoist and other equipment for its Yankee Blade property. Sulphides are appearing in the 60-ft. shaft on the Star of the West claim. The company is also planning to buy a motor-truck and to actively develop its holdings at Birch Creek. J. W. Schwebel is manager.—The Richardson and Hiawatha tunnels of the Austin Nevada Consolidated are showing ore containing silver and gold.

Kimberly.—Good progress is being made by the Consolidated Copper Mines Co. in sinking the Alpha shaft, which has now reached a depth of 1640 ft. A diamond-drill hole has just been completed at the extreme western end of the 1300-ft. level. This passed through 20 ft. of ore averaging 7.28% copper between the 1300 and 1400-ft. levels and a second body 65 ft. thick which averaged 7.1% copper. The bottom of this ore is at a depth of 1555 ft. Active development is also in progress at the Taylor mine on the north contact.

OREGON

Gold Hill.—F. H. Van Horn, representing Victor W. Brown and associates of Pittsburgh, Pennsylvania, has taken a lease and option to buy the old Sylvanite group of quartz-gold mines two miles north-east of Gold Hill. The property was recently operated by the Gold Hill Mines Co., of which J. W. Davies of Sacramento, California, is the head. It was closed down last summer, due to the scarcity of labor and the high cost of mining. Davies is now on the ground and announces that the lessees propose to resume as soon as they can repair the mine and mill equipment. The property has a 10-stamp mill and other machinery, driven by electric power. Considerable interest has been attached to this property since the discovery, in March 1916, of tungsten in the form of scheelite along with the gold ores. The mineral occurs in small stringers of quartz. Samples have been taken from these quartz veins which run as high as 40% tungstic acid, but it is said by the management that the vein as a whole runs less than 2%. The veins carrying the best grade of tungsten have been developed to only a small extent, but more work will be done.

WASHINGTON

Spokane.—Extensive preparations are being made for the annual Northwest Mining Convention which meets here February 16 to 21. The convention has come to be regarded as a most interesting and useful annual event by the mining people of Washington, Idaho, Oregon, Montana, and British Columbia. A comprehensive program is being arranged and a large attendance is expected.—Sinking has been in progress on the Ololim copper vein on the former Spokane Indian reservation, under the management of James Keeth of Spokane. Some copper ore has been shipped to the smelters. The construction of the State road to Detillion bridge will open the mineral-belt of the Spokane River valley north-west of Davenport, which is now producing copper, silver, tungsten, and coal in paying quantities. Transportation conditions have been the main drawback to the opening of this country.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

F. C. Frey has gone to Mazatlan, Mexico.

R. B. Todd, of Reno, is in San Francisco.

Charles Butters has gone to San Salvador.

W. A. Meloche has returned from Mexico to Seattle.

E. K. Soper has returned to New York from Trinidad.

Augustus Locke is in the Christmas district of Arizona.

Ellsworth Daggett, of Salt Lake City, is at the Hotel Biltmore.

A. A. Boyd is manager of the Mount Morgan mine, in Australia.

Oscar Lachmund, of Spokane, was at Salt Lake City recently.

Eugene H. Dawson has returned to New York from Alaska.

F. Le Roi Thurmond has gone from Seattle to Swansea, Arizona.

Angus Mackay has gone from San Francisco to Butte, Montana.

Eugene Davis has returned from a visit of inspection to Eureka, Nevada.

H. R. Bostwick is at Yokohama; he is not expected in San Francisco until June.

Francis J. Heney is president of the Swisshelm Gold-Silver Co., at Tucson, Arizona.

Samuel J. Nasmith has returned from the Dolly Varden mine in British Columbia.

R. A. Grimes, of Sandon, B. C., has been in San Francisco for the purpose of testing a shipment of ore.

W. Mont Ferry is now managing director for the Silver King Coalition Mines Co., at Park City, Utah.

P. S. Janderup is constructing engineer for the Balbach Smelting & Refining Co., at Newark, New Jersey.

Ira B. Joralemon has become assistant general manager of the New Cornelia Copper Co.'s mine at Ajo, Arizona.

W. B. Bishop is smelter superintendent for the Granby Consolidated Mining, Smelting & Power Co., at Anyox, B. C.

Brokaw, Dixon, Bonnelly, Garner & McKee have moved their offices from 120 Broadway to 90 West street, New York.

Charles W. Botsford and **P. G. Spilsbury** have returned from an examination of the Volcano mine at Stein's Pass, New Mexico.

Thomas M. Owens has been promoted from superintendent of mills to assistant manager for the Federal Mining & Smelting Co.

T. H. Jenks is leaving El Paso for the Texas and Louisiana oilfields, and expects to be in New York about February 1, care of the Institute.

D. D. Moffat, consulting engineer of mills, and **E. W. Engelmann**, consulting research engineer for the Jackling properties, are at McGill, Nevada.

R. G. Casey, of the Mount Morgan Gold Mining Co., in Queensland, has been investigating copper-leaching processes in this country; he is now at Victoria, B. C.

S. K. Dahl, who recently returned from a four years residence in South Africa, where as mill-superintendent he modeled and operated the Messina Transvaal Development Co.'s concentrating plant, has joined the firm of Otto Wartenweiler & Company, at Los Angeles.

THE METAL MARKET



METAL PRICES

San Francisco, January 20

Aluminum dust, cents per pound	65
Antimony, cents per pound	11 00
Copper electrolytic, cents per pound	10 50
Lead, net, cents per pound	8 75-9 75
Platinum, pure, per ounce	\$150
Platinum, 95% iridium, per ounce	\$180
Quicksilver, per flask of 75 lb.	\$90
Spelter, cents per pound	11 00
Zinc dust, cents per pound	12 50-15 00

EASTERN METAL MARKET

(By wire from New York)

January 20—Copper is dull and easy. Lead is quiet and firm. Zinc is inactive and steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1 01 1/2 on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London		Average week ending	
Jan.	14.	cents	pence	Dec.	9.
"	15.	136.75	81.50	"	16.
"	16.	135.00	79.00	"	23.
"	17.	130.75	77.00	"	30.
"	18.	128.50	77.25	Jan.	6.
"	18 Sunday			"	13.
"	19.	129.50	79.00	"	20.
"	20.	131.75	79.12		

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	75.14	88.72	101.12	July	78.92	99.62	100.36
Feb.	77.54	85.79	101.12	Aug.	85.40	100.31	111.35
Mch.	74.13	88.11	101.12	Sept.	100.73	101.12	113.92
Apr.	72.51	95.35	101.12	Oct.	87.38	101.12	119.10
May	74.61	90.50	107.23	Nov.	85.97	101.12	127.57
June	78.44	99.50	110.50	Dec.	85.97	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Jan.	14.	19.25	Dec. 9.
"	15.	19.25	" 16.
"	16.	19.25	" 23.
"	17.	12.12	" 30.
"	18 Sunday		Jan. 6.
"	19.	19.12	" 13.
"	20.	19.00	" 20.

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	29.53	23.50	20.43	July	29.67	26.00	20.82
Feb.	34.57	23.50	17.34	Aug.	27.42	24.00	23.51
Mch.	36.00	23.50	15.05	Sept.	25.11	20.00	22.10
Apr.	33.16	23.50	15.23	Oct.	23.50	20.00	21.00
May	31.09	23.50	15.91	Nov.	23.50	20.00	20.45
June	32.57	23.50	17.53	Dec.	23.50	20.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Jan.	14.	8.75	Dec. 9.
"	15.	8.75	" 16.
"	16.	8.75	" 23.
"	17.	8.75	" 30.
"	18 Sunday		Jan. 6.
"	19.	8.75	" 13.
"	20.	8.75	" 20.

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	7.64	6.85	5.60	July	10.93	8.03	5.53
Feb.	9.10	7.07	5.13	Aug.	10.75	8.05	5.78
Mch.	10.07	7.26	5.24	Sept.	9.07	8.05	6.02
Apr.	9.38	6.99	5.05	Oct.	6.97	8.05	6.40
May	10.29	6.88	5.04	Nov.	6.38	8.05	6.76
June	11.74	7.59	5.32	Dec.	6.49	6.90	7.12

TIN

Prices in New York, in cents per pound:

Date		Average week ending	
Jan.	14.	8.75	Dec. 9.
"	15.	8.75	" 16.
"	16.	8.75	" 23.
"	17.	8.75	" 30.
"	18 Sunday		Jan. 6.
"	19.	8.75	" 13.
"	20.	8.75	" 20.

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	44.10	85.13	71.50	July	62.60	93.00	70.11
Feb.	51.47	85.00	72.44	Aug.	62.53	91.33	62.20
Mch.	54.27	85.00	72.50	Sept.	61.54	80.40	55.79
Apr.	55.63	88.53	72.50	Oct.	62.24	78.82	54.82
May	63.21	100.01	72.50	Nov.	74.18	73.67	54.17
June	61.93	91.00	71.83	Dec.	85.00	71.52	54.94

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date		Average week ending	
Jan.	14.	9.72	Dec. 9.
"	15.	9.60	" 16.
"	16.	9.55	" 23.
"	17.	9.55	" 30.
"	18 Sunday		Jan. 6.
"	19.	9.55	" 13.
"	20.	9.60	" 20.

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	9.75	7.78	7.44	July	8.98	8.72	7.78
Feb.	10.45	7.97	6.71	Aug.	8.58	8.78	7.81
Mch.	10.78	7.87	6.53	Sept.	8.33	9.58	7.57
Apr.	10.20	7.04	6.49	Oct.	8.32	9.11	7.82
May	9.41	7.92	6.43	Nov.	7.76	8.75	8.12
June	9.63	7.92	6.91	Dec.	7.84	8.40	8.09

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Average week ending	
Jan.	23.	95.00	Jan. 6.
"	30.	85.00	" 13.
"			" 20.

Monthly averages

Jan.	1917	1918	1919	July	1917	1918	1919
Jan.	81.00	128.08	103.75	July	103.00	120.00	100.00
Feb.	126.25	118.00	90.00	Aug.	115.00	120.00	103.00
Mch.	113.75	112.00	72.80	Sept.	112.00	120.00	102.60
Apr.	114.50	115.00	73.12	Oct.	102.00	120.00	86.00
May	104.00	110.00	84.80	Nov.	102.50	120.00	78.00
June	85.00	112.00	94.40	Dec.	117.42	115.00	95.00

MONEY AND EXCHANGE

Recent discussion regarding fall in reserve ratio of reserve banks to near the danger limit of 40% has led to a misunderstanding in certain quarters regarding the requirements in this particular. Ratio figures referred to recently are based on an arbitrary standard fixed by the Federal Reserve Board, and constitute no legal requirement. The Federal Reserve law fixes two minima of reserves for reserve banks—35% of total cash reserves against net deposits and 40% gold against Federal Reserve notes outstanding. Some time ago, as a practical basis of operation, reserve banks adopted the ratio of total reserves to net deposits and Federal Reserve note liabilities combined, and recognized 40% as an arbitrary minimum to work from. To all intents, a rise or fall of this ratio portrays varying reserve conditions.

But reserve banks still observe the legal requirements of reserve and each week publish, in addition the ratio of gold reserves to Federal Reserve notes in circulation, after setting aside 35% against net deposit liabilities. So long as the banks keep their gold reserves, against notes outstanding above 4% they are conforming not only to the law but to the recognized standard of sound banking. Instead of a ratio around 40%, reserve banks, as a matter of fact, have been holding a ratio of gold reserve against notes around 50%. Last week the ratio stood at 49.5% for the entire system, compared with 43.7% of total reserves to net deposit and note liabilities combined. The New York Federal Reserve bank last week reported gold reserves against notes as 42.4%, compared with the break below the arbitrary minimum, to 38.7% on total reserves against net deposits and notes combined.

While the ratio of gold reserves is thus above the legal minimum, a larger decline has taken place in this ratio over the past year than in ratio of total reserves to net deposit and note liabilities combined. In the twelve-month period, gold ratio of the entire system has fallen 11.3 points, as compared with 7.4 point in total reserves against combined liabilities, and for New York Federal bank the declines have been 20.5 and 9.6 points, respectively. Loss of gold is mainly responsible, which, in the case of New York, amounted to \$111,144,000. At the same time there has been a big expansion in note circulation, as shown below:

Combined System

	Dec. 26 1919	Jan. 2, 1919
Total gold reserve	\$2,078,472,000	\$2,091,194,000
Federal Reserve notes outstanding	3,057,646,000	2,647,654,000

New York Federal Reserve Bank

	Dec. 26 1919	Jan. 2, 1919
Total gold reserves	\$570,438,000	\$486,208,000
Federal Reserve notes outstanding	874,944,000	734,932,000

The loss of gold was largely, if not entirely, due to exports out of the country, which last year exceeded imports by over \$270,000,000. If this movement continues, without corresponding contraction in note liability, it will not be long before legal reserve ratio declines to the danger point. By that time, however, the Federal Reserve Board is expected to put its corrective machinery in operation, in shape of higher discount rates. How far these measures will be effective at present in checking outward movement of gold is one of the interesting banking problems before the country.

Foreign exchange quotations on January 20 are as follows:

Sterling, dollars:	Cable	3.69 1/2
	Demand	3.68 1/2
Francs, cents:	Cable	8.62
	Demand	8.60
Lire, cents:	Cable	7.30
	Demand	7.30
Marks, cents		1.80

Eastern Metal Market

New York, January 14.

The markets do not exhibit the tendency toward wild speculation that was the feature a week ago. While demand is good it is quieter and prices in most cases are firm.

Following the heavy demand for copper during the past few weeks inquiry is not so heavy and prices are slightly lower.

Tin prices have been erratic and are again higher with heavy sales last week.

The lead market is quieter but very strong with supply still unequal to demand.

Demand for zinc, especially from foreign sources, is lighter and the market is quieter with prices a little easier.

Antimony is in better demand and considerably higher.

IRON AND STEEL

New evidence is afforded in the steel market of the large volume of unsatisfied demand and of the advancing tendency in all products in spite of the Steel Corporation's large sales at 'pegged' prices. The gain by the Corporation in unfilled orders for December amounting to 1,137,036 tons is in strong contrast to the condition of most of the independents, some of whom refrain from quoting beyond the first quarter. The calling off of the steel strike means only a little improvement in labor supply. Because of labor shortage and lack of efficiency, scarcely more than 75 to 80% operation for most plants is likely before the middle of the year, with some falling short of that now. New orders for rails continue to be placed and Eastern plate-mills have had before them in the last week about 250,000 tons in inquiries, of which 150,000 tons is for shipbuilding. There is no let up on the advance in British steel prices with all lines up generally from \$2 to over \$9 per ton.

COPPER

The market is quiet; demand is still good but lighter. This is a natural consequence of the heavy buying which appeared in November and December, particularly in December. It is now stated that December business was the "largest ever recorded in the history of copper excepting perhaps certain months during the War when blocks of copper of phenomenal size were negotiated by certain foreign governments". Some place the December business at 500,000,000 lb. Quotations are a little easier at 19.25c., New York, for electrolytic for January and first quarter delivery and 19.50c. for Lake. While stocks in the hands of producers continue large, they are diminishing, but both stocks and production are still in excess of demand. Export demand is good, and somewhat higher prices are said to be realized than on domestic orders.

TIN

The tin market continues to be largely controlled by the British speculative situation. There, values have continued to fluctuate but mostly to advance until yesterday spot Straits was quoted at £379 10s. per ton, an increase of £15 10s. over the quotation a week ago. In the last few weeks or since November 5 the London market has advanced nearly £100 per ton. There was a slight recession in values here the latter part of last week which resulted in heavy buying which on June 8 totaled about 1000 tons. The transactions ranged at from 60.25 to 61.75c., New York, the average being 61c., and this consisted of sellers taking profits, and substantial ones too, on metal bought some weeks ago at around 52.50 to 55c. per lb. Large and small consumers were buyers as well as some dealers. Yesterday, as a result of higher British prices, spot Straits was quoted at 65c., New York. There is some uncertainty whether large

consumers or consumers in general are well covered for future needs. It is possible that they are better provided for than is suspected but only the extent of the usual spring buying movement will reveal the true situation. Arrivals of metal so far this month have been 950 tons, of which 240 is credited to Pacific ports; 7370 tons is reported afloat.

LEAD

From appearances heavy demand is letting up and the market is quieter. The American Smelting & Refining Co. advanced its price on Wednesday $\frac{1}{4}$ c. to 8.25c., New York, or 8c., St. Louis, but the outside market continues far in advance with prices very firm. Spot-lead is still exceedingly difficult to obtain and the quoting of a nearby market is difficult. Opinions vary, some claiming that this position is at least 9c., New York. It is probable that the bottom is not less than 8.75c., New York, with a fair appraisal at 8.87 $\frac{1}{2}$ c., New York, or 8.62 $\frac{1}{2}$ c., St. Louis, which we quote as the market. Some buying for export of lead in bond is reported.

ZINC

This market is much quieter than last week, due to a let-down in speculative activity in London. Values here continue to follow largely the fluctuations in that market, the principal demand coming from that quarter. There has been an easing in British prices and a consequent slight decline here, values fluctuating mildly each day. Prime Western for early or first quarter delivery is quoted at about 9.37 $\frac{1}{2}$ c., St. Louis, or 9.72 $\frac{1}{2}$ c., New York, with demand fair. It is acknowledged that buying for export, particularly by England, has been very heavy in the last few weeks. Domestic demand continues light. Galvanizers are only partially covered, having some stocks unused because of the steel and coal strikes. They will, however, undoubtedly be heavy buyers soon.

ANTIMONY

The market is much stronger on better demand and diminished supply. Reports from China are that supplies are hard to obtain for export. Wholesale lots, five tons and larger, are quoted at 10.25c., New York, duty paid, for early delivery, with jobbing lots about 11c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted at 31.50 to 32.50c., New York, for wholesale lots for early delivery.

ORES

Tungsten: Until the tariff matter is settled there seems very little prospect of much business and a settlement of this question by the Senate seems far off. The market is very dull as a consequence and quotations are largely nominal at \$7 to \$15 per unit in regular concentrates. Some Chinese ore is reported sold in the last week at \$6.50. Ferro-tungsten is nominally quoted at \$1 to \$1.15 per lb. of contained metal.

Molybdenum: A small business is reported at the prevailing prices of around 75c. per lb. of MoS₂ in regular concentrates.

Manganese: The market is strong and ores are scarce. It is stated that American makers of ferro-manganese are now willing to pay 75 to 80c. per unit. Imports in November are returned as only about 11,000 tons, the smallest of any month for the year.

Manganese-Iron Alloys: Ferro-manganese continues to advance and supplies are not more plentiful. Almost no domestic alloy is procurable for first half; only small lots for spot delivery are reported for which \$175 to \$180, delivered, is asked. Even low-grade alloy, 70%, is held at \$150, delivered, for spot.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE DEVELOPMENT OF THE ROCK-DRILL IN AMERICA

By Charles Austin Hirschberg

*In 1879 the discovery of the lead-carbonate silver ores of Leadville gave renewed impetus to the mining development in Colorado. It was about this time that the miner put aside his single-hand hammer and steel in favor of the power rock-drill, invented by J. J. Couch of Philadelphia in 1849 and perfected during the intervening years by Couch and J. W. Fowle of Boston, patent rights finally being purchased by Charles Burleigh about 1866. The Burleigh drill was used in driving the Hoosac tunnel in the year 1867.

In 1871 another power-drill was invented by Simon Ingersoll.

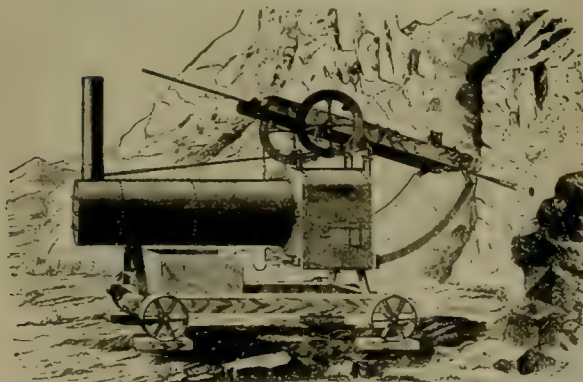


Fig. 1. The Couch Rock-Drill. The First Power Drill

soll, and other similar drills, such as those of Wood, Sergeant, Waring, Halsey, and Githens, made their appearance.

From this time on, the primitive methods of mining gave way rapidly to the so-called reciprocating-piston rock-drill, which comprised a cylinder carrying a piston with a projecting end, to which the drill-steel was fastened rigidly.

The year 1894 marked another stage of progress. It was then that J. George Leyner, a native of Colorado, born in Boulder county, opened his small machine shop in the city of Denver, for the repair of mining machinery. This enterprise led him into numerous experiments with the power rock-drill, culminating in the invention of the first hammer-drill about 1897, a type in which the piston moves freely in the cylinder and strikes upon the drill-steel instead of being attached fixedly to it, and pushing it as in the reciprocating type of drill, a direct reversion to the principle involved in the primitive method of hammering the drill by hand.

There is no questioning the debt the mining industry owes to the invention of the reciprocating type of rock-drill, but it remained for a Western man, Mr. Leyner, born in a mining community, to make this scientific step in the

art of drilling rock. No need to dilate at length upon the things he accomplished in the invention and development of the hammer-drill, such as the introduction of water and air through hollow-drill steel for cleaning the hole,

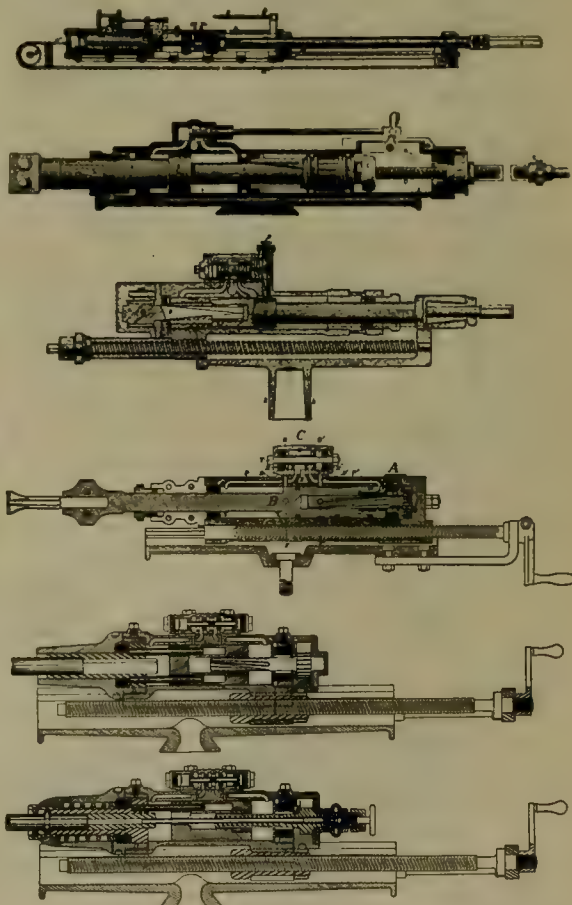


Fig. 2. Showing From Top to Bottom: 1. Fowle's First Rock-Drill. 2. The Burleigh Drill Used in Hoosac Tunnel. 3. The Wood Drill. 4. The Ingersoll Eclipse Drill. 5. Leyner's Hammer-Drill of 1897. 6. Leyner's Drill of 1898.

automatic lubrication, throttle-control enclosed in the machine, mechanical rifle-bar-rotating drill-steel chuck. All hammer-drills of the present day, irrespective of maker, have borrowed important features from the Leyner machine.

In testimony to the correctness of his theories, his business grew to a point where in 1905 he was forced to build a modern manufacturing plant at Littleton, Colorado, to take care of a rapidly growing enterprise, ending in the purchase of license rights by the Ingersoll-Rand Co. of New York, since which time further modifications and refine-

*Published by courtesy of 'Compressed Air Magazine'.

ments have been made, as typified in the Leyner-Ingersoll drill.

Still another product of Colorado's inventive genius is the creation of the stoper-drill, which depends for its success upon an air-feed attachment to a drill-cylinder, first experimented with by C. H. Shaw of the C. H. Shaw Pneumatic Tool Co., at Denver, in 1906, followed rapidly by the Waugh slugger, also an air-feed type of machine, then the Crown air-feed drill of the Ingersoll-Rand, the Hardscog

product, followed rapidly by such machines as the Sullivan hand-hammer drill, the Hardscog Little Wonder, the Cleveland hand-drill, Meyner Brownie, and numerous others.

In the year 1909 the first real self-rotated hand-hammer drill made its appearance. Following the practice of making drills out of stopers, Mr. Leyner conducted extensive experiments with a Leyner drill-cylinder removed from its shell. He placed a T handle at the back with handles part-

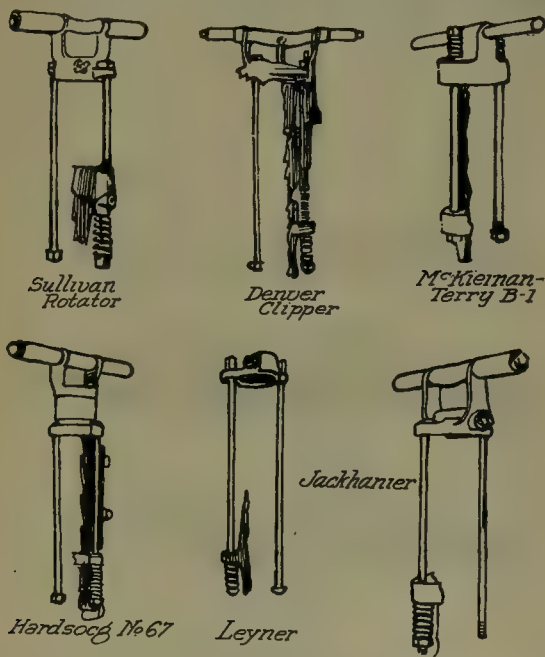


Fig. 3. Side-Rod Construction

Wonder rock-drill, the Sullivan, the Cleveland, the Leyner stoper, and the Chicago.

These inventions were the progenitors of other styles of

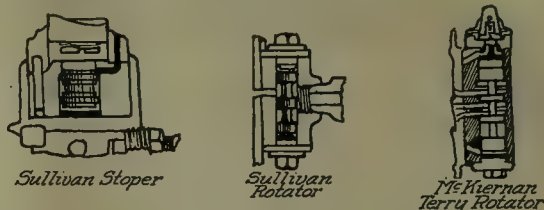


Fig. 4. Detail of Valve-Action

way down the cylinder. He built several of these machines, more particularly for shaft-sinking. However, before he had gone far the Ingersoll-Rand Co. obtained a license to manufacture and sell under the Leyner patents, and as

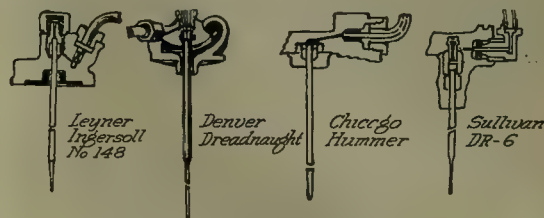


Fig. 5. Detail of Water Mechanism

early as 1912 the Jackhammer, the first self-rotating hand-hammer drill employing Leyner rifle-bar and sleeve-chuck rotation, was placed on the market. It proved such a success that other manufacturers brought out modified designs.

We often hear it said that there is nothing new under the sun. To some extent this saying may be applied to

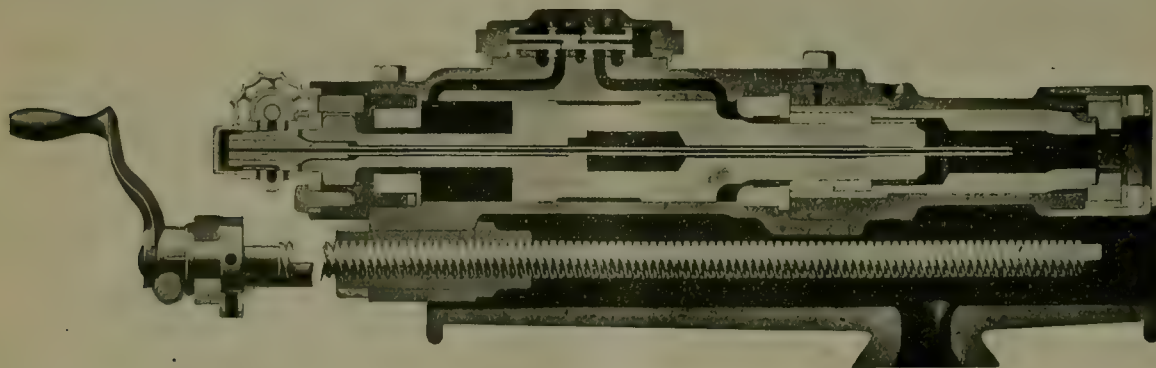


Fig. 6. Cross-Section of No. 5 Water-Leyner

hammer-drills; in fact, the latter may be termed modifications of these first types. For instance, the majority of the early hand-hammer drills (excepting plug-drills, employed for drilling shallow holes in granite and stone) were largely patterned after the air-feed stoper, the air-feed being eliminated and a spade-handle substituted; indeed, the manufacturers of these early stopers advertised the interchangeability of handle and air-feed as a useful feature.

This early practice of interchangeability was, however, soon abandoned, for while good in theory it proved impracticable. Then came the Little Jap drill, an Ingersoll-Rand

present-day drill designs. Things that had been tried and tested in the early struggle with reciprocating drills, and later with the first Leyner drills, but abandoned because of their failure to perform as expected, and again in the latter case, because of the impossibility of securing suitable material and a lack of knowledge in those days of refined methods of heat-treating to enable material to stand up under the particular work they were to perform, are today making their appearance in the designs of many drills and are exploited as new.

Referring to Fig. 2, this shows the first reciprocating

rock-drill, as used by Burleigh in driving the Hoosac tunnel in 1867, a project fathered by the State of Massachusetts. The tunnel was five miles long, driven through hard rock. It was an ambitious scheme for those days, involving at its start the employment of hand-drilling. That the work in driving this tunnel was carried to a successful conclusion was largely due to the efforts of J. W. Fowle of Boston, who invented the Burleigh rock-drill. Burleigh's part in the development of this first drill rested with certain improve-

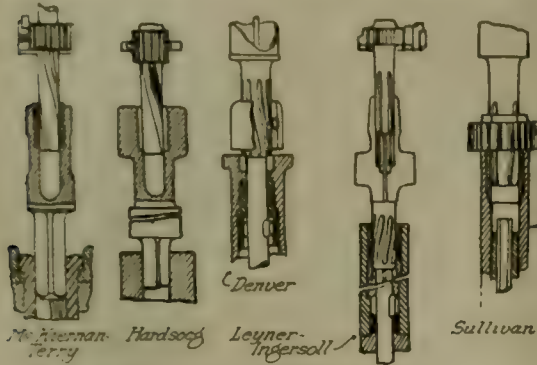


Fig. 7. Hammer-Drill Rotation-Mechanism

ments that he made as a mechanic in the shops of the Fitchburg machine-works, where the drill was built.

The Wood drill, shown in Fig. 2, was brought out shortly after the Burleigh drill had been used in the Hoosac tunnel. In the testimony before the Massachusetts legislature appears the following statement: "We were satisfied that this drill was an entire infringement on Mr. Burleigh's patents, and that our obligations to Mr. Burleigh ought not allow us to suffer the Michigan drill (Wood) to be used by our contractors."

Next came the Ingersoll drill, first used in 1871. This employed a tappet-valve action and followed somewhat new lines of design in that it utilized a guide-shell with feed-screw for feeding the machine forward, making it much

Fig. 2 shows the Ingersoll Eclipse air-thrown valve drill, which was an improvement over the Ingersoll drill invented by Henry C. Sergeant in 1873 and brought to its final state of development in 1878. This was the first independent valve-motion control. The Ingersoll Eclipse drill was employed in driving such tunnels as the Cascade, Bozeman, Silverbow, Skaklyou, Snow Shoe, Vosburg, Coosa Mountain, Wickes, and the Croton aqueduct.

In the meantime the Slugger rock-drill was invented by Halsey and introduced by the Rand Drill Co., now the Ingersoll-Rand Co., in 1883. This machine, it will be noted, is equipped with side rods and a flat back-head spring to absorb shocks. The valve is of the piston or spool type. While having an independent valve action it was without variable stroke. It was largely used in mine work and in some of the big aqueduct-tunnels.

A great many of our modern drills employ independent air-thrown valve-actions patterned largely after these two first types. Even the first Leyner hammer-drill borrowed the spool valve from these early constructions. Fig. 4 shows the valve action of a number of makes.

In 1884 the Sergeant auxiliary-valve drill came to the front, bringing with it the release rotation and a spool-valve motion controlled by a crescent-shaped piece in contact with the main piston. This type of drill largely replaced the Little Giant in the Lake Superior mines and drove the Catskill aqueduct-tunnels and many others, among them the Pennsylvania tunnel under the East River, New York. The release rotation feature of this type of drill gradually found its way into other makes of drill, including the No. 6 Water Leyner drill brought out by Leyner in 1906.

Starting about 1899 up to the present time we pass through a revolution in the mechanics of the rock-drill. This is the period of hammer-drills and we see the gradual passing of the piston-drill. Leyner's drill as shown in Fig. 2 made its appearance in 1897, followed by the type of drill shown in Fig. 2, in 1898, it being the first of his or any other drill to employ water and air through the drill-steel.

Referring to Fig. 5 we find present-day builders of hammer-drills borrowing in its essential details the water

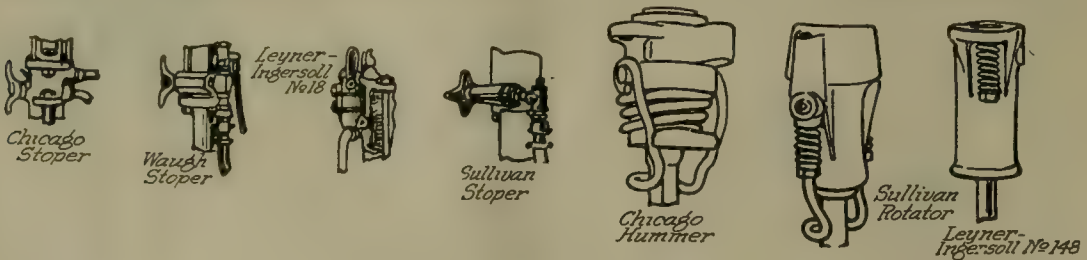


Fig. 8. Throttles and Front-Heads

lighter and, therefore, possible to mount on a so-called bar in place of a carriage. It was employed in the Musconetcong tunnel of the Lehigh Valley Railroad.

The Rand Little Giant drill was subsequently developed by A. C. Rand and George Githens in 1875. This also employed a tappet-valve action controlled by the motion of the piston to operate the valve. It was with this type of machine that the side-rod construction made its appearance, which is found even today in later drills, such as the present-day Leyner-Ingersoll, the Sullivan water-drill, the Sullivan piston-drill, the Denver Dreadnaught, and many others. See Fig. 3.

The Rand Little Giant drill was largely adopted throughout the Lake Superior iron country as well as certain parts of the copper country. Some of its notable work is the Hell Gate channel excavation and the Weehawken tunnels.

and air principle of the Leyner drill. Fig. 6 illustrates the No. 5 Leyner drill brought out about 1903, showing substantially the same type of rotation first employed in the later models of Leyner drills, except that it had a locking key for holding the steel in the chuck, which feature was abandoned in the Model 6, already referred to, and later types.

Fig. 7 shows the rotations of various makes of hammer-drills, which it will be noted correspond in main essentials to the Leyner type. The No. 7 Leyner drill may be said to be the real father of all existing hammer-drills. It includes in its design the Sergeant release-rotation feature, the rifle-bar rotating sleeve-chuck feature, the water and air feature, and the first automatic lubricator, as well as the enclosed machine-throttle construction, and one-piece solid-front head and finally, split-front head with through-bolt retained front-

head cap. It is interesting to note the variations of features of those designs as found in other makes of machines, as shown in Fig. 8, including the mounted hammer-drills, self-rotating hand-hammer drills and stoper drills with their air-feed attachments as well.

It is interesting to compare the advance that has been

made in the self-rotating hand-hammer drill, starting with Leyner's first experimental machine constructed in 1909, on through to the Ingersoll-Rand Co.'s various Jackhammer types, Sullivan Rotator, Denver Rock Drill Co.'s Clipper drill, Chicago Pneumatic Co.'s Hummer, McKiernan-Terry, Busy Bee, and many others, as shown in Fig. 9.

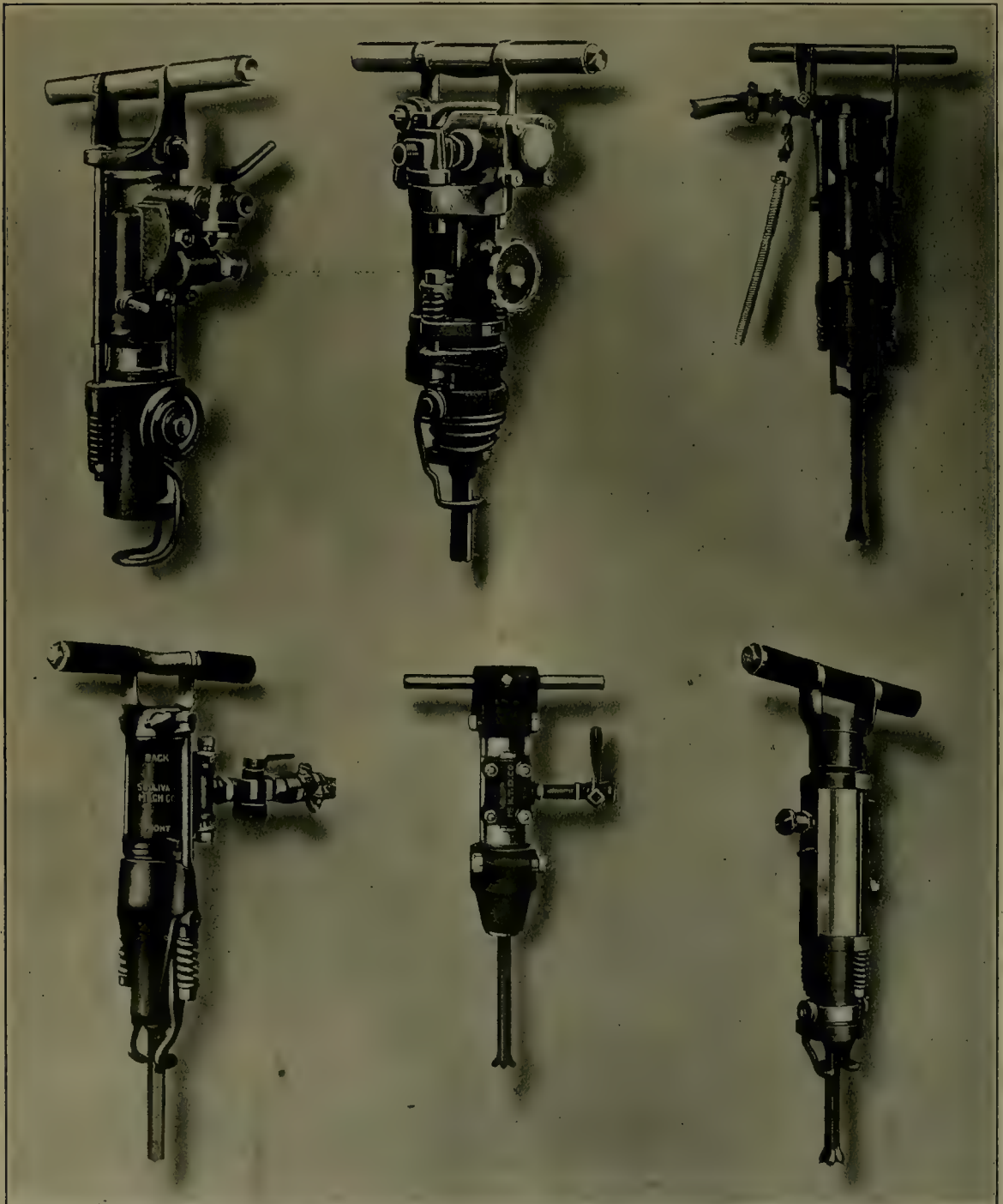


Fig. 9. Various Self-Rotating Hand Hammer-Drills. Top Row Left to Right: Ingersoll-Rand Jackhammer, Chicago Hammer, Denver Clipper. Bottom Row, Left to Right: Sullivan Rotator, McKiernan-Terry Busy Bee, Hardsocg

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Deasy Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JANUARY 31, 1920

\$4 per Year -15 Cents per Copy

TABLE OF CONTENTS

Page

EDITORIAL

NOTES 143

HOOVER FOR PRESIDENT 145

The evident sentiment in his favor. His generalship, as the head of an administration. All the members of the Food Administration are eager to support him for the highest office. The New York 'World's' pronouncement in his favor. His supporters belong to both parties. He is not a candidate yet; all action that way is spontaneous. A real American with a world vision.

INTERVENTION IN MEXICO 146

The Mexican people, their ethnic composition chiefly Indian. Large proportion of illiteracy. 'Spanish' only in name. A poor contribution for the 'melting-pot' of the United States. The danger of a further admixture with our ten millions of negroes. Need for careful investigation and the formulation of a fixed national policy.

DISCUSSION

SIMP SPELLING

By Harold Abbot Titcomb 147

Two facts overlooked by proponents. Pronunciation is not uniform; nor is it stable.

By E. M. Hamilton 147

Another protest. Movement involves reform in pronunciation as well as in spelling. This should not be left to irresponsible individuals or societies.

A STABLE GOVERNMENT FOR MEXICO

By Resident Observer 148

The heterogeneous population. Characteristics of the 'Indians'. The Diaz regime. Perennial brigandage. Conditions of intervention. What are the ideals of Mexico?

ARTICLES

ELEMENTS OF SMELTING-PLANT DESIGN - I

By Oliver E. Jager 153

General considerations. Size of plant required. Economics of problem. Effect of local conditions. Selection of the process. Generalized flow-sheet. The chemical nature of the ore to be smelted.

THE MINING INDUSTRY IN AUSTRALIA

By F. H. Bathurst 158

The anti-German crusade of the early-war period. Government interference in the industry. Withdrawal of men for army service. Gold mining situation bad. High cost of supplies. Fresh discoveries notably absent. Development of coal.

THE TWO PROFESSIONS OF MINING GEOLOGY

By Augustus Locke 161

'Court' geology, as distinguished from 'ore-hunting' geology. Distinct professions. Elm Orlu v. Butte & Superior, as an example. Prejudice. The judicial temperament.

STATISTICAL REVIEW 163

Production of metal mines during 1919 in Colorado; Idaho; Oregon; South Dakota; Texas; and Utah.

NOTES

LABOR UNREST IN SOUTH AFRICA 157

DEPARTMENTS

REVIEW OF MINING 167

THE MINING SUMMARY 173

PERSONAL 174

THE METAL MARKET 175

EASTERN METAL MARKET 176

BOOK REVIEWS 177

RECENT PUBLICATIONS 177

INDUSTRIAL PROGRESS 178

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



Building up low-joints in street railway tracks.

AS LIKE AS TWO PEAS

EACH cylinder of Linde oxygen is filled as though it alone was intrusted with the reputation of Linde.

The oxygen which goes into it, and into all the other thousands upon thousands of Linde cylinders, is so hedged with factory tests that it can be only of high purity—but uniformly so.

The very fact that each cylinder valve is triple tested to assure tightness before leaving the plant means that

every tank is full to its capacity, and will remain so.

In the span of a day—even in the span of years there is never a moment when the continuity of tests is broken. And should the oxygen show the slightest divergence from the high and uniform purity Linde always maintains it is discharged into the air.

And because the expense of these diligent tests is spread over the largest oxygen business in the world the cost is not felt by the consumer.

THE LINDE AIR PRODUCTS CO.

30 East 42nd Street, New York

Kohl Building, San Francisco

The Largest Producer of Oxygen in the World



THE Northwest Mining Convention will meet at Spokane on February 16 and the five following days.

WE have received a contribution to discussion signed 'Claimant'. The writer of it has failed to give his name and address. We do not publish anonymous communications; it is an unwritten rule in respectable journalism to disregard such letters. The name of the sender must be given, even though the writing itself is published under a pseudonym. Usually we prefer to publish letters from those who are willing to fight in the open.

IT is reported from Washington that the Committee on Mines and Mining of the House of Representatives has been holding hearings on the legislation proposed for liberalizing the War Minerals Relief Act. Witnesses from all parts of the country have been heard and the Committee has shown keen interest in the matter. Meanwhile a few claims have been settled, most of them after amputation, and some measure of progress is being made by the Commission.

NEW gold from South Africa is being sold in London at a premium fluctuating between 20 and 25%, as previously recorded in these columns, but payment is made in pounds sterling, which have depreciated 24%; in short, the appreciation of gold and the depreciation of sterling exchange are complementary, and parts of the same process of economic adjustment. The market-value of South African gold has not risen in terms of the dollar. However, the mining companies on the Rand pay for labor and supplies in British currency, so they obtain the full benefit of the premium on gold as paid in their market, which is London. Here we may note that the Mount Morgan Gold Mining Company is selling its gold in China at a premium of 33%. This likewise represents the fall in sterling exchange.

HEARST is out against Hoover. That should commend the latter to the American people. Senator Reed, who made himself notorious by his malicious attacks on the Food Administrator, fills three columns of Hearst's local newspaper with a tissue of lies and absurdities. One can hardly imagine greater misuse of public money than the printing of an article from Hearst's New York 'American' in the Congressional Record; yet that was done, on the request of Mr. Reed. Hearst's scribe says that "no member of the Senate

thought well enough of Hoover's candidacy to rise and defend him from Senator Reed's attack". There was an obvious reason for ignoring it. It is regrettable that the Senate, when so much important public business is pressing, should allow its time to be wasted by pothouse talk.

STOCKS of copper are being liquidated, thanks to an increase in domestic consumption and better buying from abroad. During January several large sales were made; and if the price remains quiet, it is due mainly to the fact that those in control desire to free the market from big unsold accounts. Lead is in demand for domestic consumption. The stock of this metal in British hands amounts to about 300,000 tons, and the British government seems disinclined to part with it, thereby maintaining a menace to the market.

NICKEL coinage is being urged upon Canada, and among its advocates is Dr. Willet G. Miller. He summarizes his argument thus: "Nickel is the most durable metal for minor coins; it cannot be successfully counterfeited, and it can be called Canada's national metal, since this country produces over 80% of the world's output." Fifty countries, he says, use coins made of pure nickel or nickel alloys, and in this respect the British dominions are exceptional in using none. The American 'nickel' contains 75% copper; it is not as attractive as the similar coins made of pure nickel. There seems room for the use of more of this metal for minor coins in Canada, but in the United States we shall continue to favor our own products, copper and silver. In our last issue we noted the fact that the Canadian government, beginning with January 1, has reduced the fineness of its silver coins from 925 to 800.

GEOLGY as a science is suffering in dignity by reason of the use made of it in mining litigation. This is the subject of a vigorous article, on another page, by Mr. Augustus Locke, a mining engineer whose experience and reputation give value to his remarks. He is frank in his utterance, but, of course, without personal antagonism toward any of the worthy gentlemen whom indirectly he criticizes. It is the custom, not the men, that excites his animadversion. We, like Mr. Locke, would like to see the same men engaged by the courts, instead of the litigants, to give testimony on the intricate questions of structural geology upon which the decision of apex-suits mainly depends. If they were to testify as impartial

observers, the lawsuits would be expedited and rendered less fortuitous in their results, but the greater gain to the mining industry would be the accumulation of accurate information concerning the structure and distribution of ore deposits. Science, as well as justice, would be clarified, instead, as now, of being confused by partisan testimony.

ECONOMIC problems are in the foreground of the national life of the Australian commonwealth as in our own country; therefore a description of conditions there, as they affect the mining industry, will be found interesting at this time. We publish an article by Mr. F. H. Bathurst, a veteran journalist, formerly mining editor of the Melbourne 'Argus', one of the great papers of the English-speaking world. It will be noted that in the effort made by the Australians to rid themselves of the German metal octopus, they established a Metal Exchange for the registration of sales and contracts between the producers and the dealers in metals. This proved beneficial in many ways, although it did not fulfil the utmost dreams of its organizers, because there remained the jealousy between the financial groups controlling the mines. Undoubtedly the mining industry of the United States, and of the American continent as a whole, would be benefited by the establishment of a Metal Exchange in New York. At present the fixation of prices is too much of a 'trust' affair, and therefore rightly arouses suspicion on the part of the mining public.

THE 'Engineering and Mining Journal' announces the final severance of Mr. W. R. Ingalls' connection with that paper. He ceased to be responsible editor nearly a year ago, but since then, under the title of 'consulting editor', he has continued to prepare the metal averages. His resignation is an event in technical journalism, for Mr. Ingalls became editor of our contemporary in 1905 and has performed his duties with characteristic conscientiousness and thoroughness. His knowledge of the metal trades is unique and will be sorely missed by the publishers of the New York periodical. We have always questioned the accuracy of the average prices as compiled by Mr. Ingalls, simply because it is beyond the wit of man to arrive at correct figures in default of a complete record of sales, but he made a good effort to ascertain the facts, and we think it extremely unlikely that anybody less well-informed has any chance of achieving even his moiety of reliability. What New York needs is a Metal Exchange, on which all the sales are made and duly registered. As it is now, the attempt to impose the quotations of the 'Engineering and Mining Journal' on the industry is an absurdity, the reality of which is likely to be better appreciated now that Mr. Ingalls is no longer able to give them even the simulacrum of accuracy.

AMONG geological formations worthy of notice is one in the Silverton district. In a paper published at Tonopah, Nevada, we read: "The formation is rhyolite and lime, being the oldest in history—so old that no books

are available on the subject." The Silverton district was formerly known as Monte Carlo; it is not the Silverton in Colorado, where only the normal, modern, well-behaved, eminently respectable kind of rock formation is to be found. In its Nevadan namesake evidently there has been a geologic débâcle, a petrographic catastrophe, of the most subversive kind, bringing to surface a rock that has hitherto escaped the writers of textbooks. But why should the age of a rock render it immune from literary treatment? Some of the books published in 1919 describe rocks that were formed in 100,000,000 B. C. Nothing can escape the rock-sharp, not even the most antediluvian, prehistoric, primordial of limestones or rhyolites. We would like to hear more about it from our Tonopah contemporary. The formation is distinguished by enclosing or exposing "eight different groups" of "mineral finds" all of which owe their newspaper existence to the energetic exploratory work of Mr. Joe Tognoni, "the father of the district". A report has been made by a Mr. McSherry. Well, Tognoni suggests Chianti and McSherry recalls Amontillado, so here perhaps we find explanation for a certain inebriation of language, such as recalls the days gone-by, in that remote past before January 17. It is most interesting. The mining claims constitute an "estate", the veins are "most prolific", "a number of big deals are pending", and "several mining engineers, representatives of powerful financial interests in the East, have been examining the properties for the last several days". It sounds so familiar—all except the super-ancient rocks. That is a new touch. Put on another record, Mr. Promoter!

FRAUDULENT finance was fitly punished in the Pandolfo case by the 10-year sentence passed upon the irresponsible promoter of the Pan Motor Company. In that get-rich-quick affair it was shown how much such pirates depend upon a subservient press for their campaign upon the pockets of the unwary. Judge Landis condemned scathingly the editor of the Minneapolis 'News' and other newspapers that allowed Pandolfo's lying advertisements to masquerade either as news items or as special articles. The motor trade today is corrupting journalism by means of 'write-ups' not easily spotted by the unsophisticated. Readers of technical papers have good reason to resent their being served with articles that pretend to be unbiased but are furnished by the agents of manufacturers. We recognize that such articles have some value, but they are subject to discount, and the reader is entitled to know their source so that he may fix the rate of discount he sees fit. We have established a department at the end of our reading pages to which the name of 'Industrial Progress' is given. Under this heading it is stated that the information contained in the pages so designated is "furnished by manufacturers". Recently we have published two articles, on machine-drills and air-compression, furnished by two rival firms, and we have been amused to find these articles appearing in the body of our New York contemporary as if they were the writings of independent technicians. By plac-

ing 'Industrial Progress' between the last reading pages and the advertising pages, we indicate that it partakes of the character of both; it is useful information contributed by those in the trade. The average man hates to be deceived; to foist an advertisement upon him in the guise of ordinary reading-matter undermines his confidence in the editor. Such loss of confidence will cause him to abstain from reading the publication, thereby diminishing its value as a medium of publicity. Every misplaced write-up is an injury not to the readers only, but to the advertisers as well, because it entails a loss of effective publicity.

EUREKA is a Nevadan mining district that has not only yielded some 50 millions of dollars since the first work was done in 1873, but it is one that has been made famous by Monograph VII of the U. S. Geological Survey. 'The Silver-Lead Deposits of Eureka', by J. S. Curtis, was published in 1884 and has remained since then one of the most interesting applications of the science of geology to the art of mining. Among the richest mines in this district, or county, were the Richmond and Eureka, two adjacent properties owned by two companies that, in 1877, engaged in a lawsuit, which became celebrated as the forerunner of many apex litigations and the incubator of a new definition of the term 'lode'. These two mines are credited with a joint production of \$34,600,000. In 1905 they were consolidated under the control of the United States Smelting, Refining & Mining Co., on the initiative of the late Albert F. Holden. His death in 1913 and a quarrel with the minority shareholders contributed to the failure of this attempt to resuscitate an old enterprise, which has now passed into the hands of the Mining & Development Corporation of New York. Mr. Edwin O. Holter is president; Messrs. Harold Kingsmill and H. P. Henderson are the advisory engineers. They have organized a company called the Ruby Hill Development Company, for the purpose of exploring the lower workings of the Eureka-Richmond mines on Ruby Hill. No stock is being sold; we understand that the enterprise is of a private nature and that it is backed by several wealthy men connected with the Cerro de Pasco. The chief aim of exploration is to search for ore in the deeper ground beyond, or north-east of, the Ruby Hill fault, which limited the ore on the hanging-wall side of the workings above the twelfth level. The main, or Locan, shaft was re-timbered to this point by the U. S. Smelting company and the water-level now stands at 85 feet below it. Mr. J. H. Mackenzie was in charge of the pumps when in 1890 the management was struggling with a sudden influx of water; he had reached the 1200-ft. level when orders were received to cease work. He is quoted as having expressed a favorable opinion in regard to the prospects of finding ore on that level, which penetrates beyond the fault. To prevent confusion, it is necessary to state that the 12th level of the old workings is 450 feet above the 1200-ft. level from the Locan shaft. The report by Mr. Henderson on the geological structure is conservative. The chance of the

new company making a success where its predecessors failed depends largely upon the more effective machinery and cheaper power now available. It is a genuine adventure on the part of men well able to take the risks and competent to minimize them by the application of experience. We wish them good luck.

Hoover for President

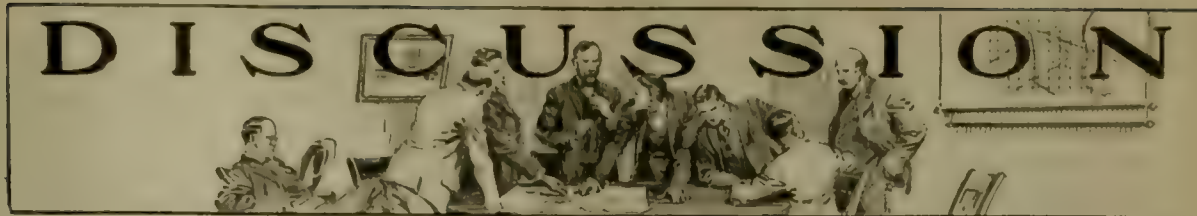
The mining profession has a special reason for interest in this subject; since we wrote on the presidential campaign in our last issue it has become evident that Mr. Hoover, without any action on his own part, is being considered all over the country as a probable nominee. A strong undertow of sentiment is apparent both in conversation and in the newspapers in favor of the man who, next to President Wilson, caught the imagination and won the confidence of the American public during the heroic years of the Great War. Mr. Wilson lost it, in part owing to his own blunders, in part owing to the course of events, which introduced the venom of party politics into the discussions over the Treaty of Peace. Indeed, President Wilson's fall from the pinnacle of fame and popularity, at home and abroad, is extraordinary; the undermining of his personal ascendancy, the discomfiture of his plans, the breakdown of his health have brought about a collapse that in its completeness has the elements of a Greek tragedy. Only a mean man can derive any pleasure in contemplating it, and the pathetic consequences of it. On the other hand, his loyal coadjutor, Mr. Hoover, has escaped from the débâcle because he is less self-centred, less of an egoist, and better able, thanks to his training and experience, to make the most of the assistance placed at his command for the national service by a staff of clever men. It is the mark of generalship to be able to select good captains. Mr. Hoover has that characteristic, and its corollary also, namely, the ability to stimulate the powers of those who work with him. This is proved by the record of the Food Administration, as also by his later operations for relief in Europe. It is not surprising therefore that at this moment, unintentionally, he possesses a national organization eager for the chance to work in his behalf as a presidential candidate, for every member of the Food Administration would rally to the call of the Chief in an instant, should occasion arise, as seems now so likely. More than that, the Food Administration did good work; the men and women of this country know that it did; they complied with its regulations because the Food Administrator early gave the impression that he knew what he was doing; he was sagacious as well as humane. Thousands are eager to vote for him in total disregard of party ties. Every politician is keenly aware already that Mr. Hoover is the one man that can attract votes from the opposite party, whichever should nominate him. The New York 'World', a Democratic newspaper, has declared that it will be glad to support Mr. Hoover "as an independent candidate on a platform of progressive liberalism", adding: "We should not hesitate to support him as a Republican candidate on

a platform representing the kind of government which Hoover has exemplified in his public career." On the other side, many Republicans are saying that they will support him even if nominated by the Democrats. Party politics is in bad odor; the performances in Congress have sickened thoughtful men; the sacrifice of vital interests to partisanship has been too flagrant. There is a great work of reconstruction to be done during the next four or five years, and it will need the leadership of a man built on a scale of twelve inches to the foot. Most of the men named for the Presidency are political cordwood, not presidential timber; before June arrives they will be weighed and found wanting. Meanwhile Mr. Hoover is not a candidate; he has taken no steps to place his name before either party; not even his personal friends have been asked to make an effort in his behalf; anything that is being done is spontaneous. He stands aside as yet, not anxious for the call, but, like a good citizen, ready to obey if it have the authentic note of patriotic duty. He admired and supported Roosevelt; he admired and assisted President Wilson at a time when it was every American's bounden duty to rally to the Chief Executive; he is a liberal, a man of progressive ideas, a practical humanitarian, a just man, able to recognize the rights and wrongs of the economic struggle, but neither a mollycoddle nor a pussyfoot; he has seen enough of foreign ways to appreciate American ideals the more; he is the exponent of a virile Americanism that stands between the gushing internationalism of Woodrow Wilson and the frothy provincialism of Hiram Johnson. Gentlemen of the mining profession, let us elect him!

Intervention in Mexico

On another page we publish a letter from a mining engineer in Mexico on the subject of government in that distressful country. It contains much interesting information. The word 'Mexican', as an ethnologic term, is much misunderstood; so is the use of 'Latin America'. Most of the countries south of us are peopled by their aboriginal population, together with a relatively small admixture of those of European, chiefly Spanish, blood. In Mexico itself there are barely a million persons of undiluted Spanish ancestry; a large proportion of the half-breeds like to call themselves 'Spanish', but the people of Mexico are 75% Indian and 85% illiterate. Out of a population of about 16 millions, 6 millions do not speak the official language of the country; instead they have fifty different languages and innumerable dialects of their own. This is not the kind of stock that it is advisable to add to the 'melting-pot' on this side of the Rio Grande. The problem arising from our contiguity to Mexico is one that should receive the most serious investigation. As yet it has been tackled in a desultory and irresponsible manner. 'Watchful waiting' aided by such interpreters as Messrs. John Lind and Lincoln Steffens is not a satisfactory solution of the difficulty. The destiny of the United States hinges so largely on its treatment of the Mexican people that it would seem the

part of wisdom to appoint a commission of competent men to study the subject and report upon it, so that a national policy may be adopted, one that both political parties will agree to accept. To make our attitude toward Mexico merely the reflex of our own partisan politics is manifestly childish, because it will affect generations unborn. On account of our interest in the mining industry of Mexico, that is to say, our desire to see American exploitation in that country rendered safe and successful, we wish greatly that amicable relations may be established as a preliminary to the restoration of law and order, particularly in those remote localities where the mines are mostly situated; but there is more at stake than the welfare of American mining enterprise in Mexico. The welfare of the United States is at stake. If military intervention were forced upon us, either by Mexican action or by Hearst's yellow journalism, we would have to occupy the country, and possibly, in the end, annex it. There lies the danger. To add 12 millions of Indians to 10 millions of negroes would introduce a factor highly dangerous to our civilization. Already the stock that leavened the American people, and gave it the strong character reflected in its institutions during the 144 years of its national life, has been diluted, if not corrupted, by an influx of the poorer racial stocks brought to this country in an effort to obtain a sufficiency of cheap labor. The birth-rate of those of early American descent is small, and it is decreasing; that of the horde of uneducated immigrants is high, and it is maintained. The negro is prolific; so are the peons of Mexico. It is written in history that the lower breeds multiply at the expense of the higher; the outposts of Spanish civilization were swamped by miscegenation. The white people of the United States are trying to develop a high type of civilization, one based upon representative government; they are endeavoring to assimilate the diverse alien elements constantly arriving from Europe; they are hoping to create an American stock worthy of the fathers of this republic; is the greatest experiment in political chemistry to be spoiled by introducing reagents known to be of adverse composition; is the dream of an American nation to be made a nightmare of intermingled litters—yellow, brown, and black? It behooves us to face the facts with sober mind. The mere drifting called 'watchful waiting' leads nowhere; it is a negation of policy liable at any moment to be swept aside by popular clamor or private intrigue. For military intervention, without some well-thought purpose, wise and humane, the American people have no fancy. Pacifism is now deeply ingrained in the national spirit; this generation at least has had enough of war. There remains only a policy that will help the decent elements in Mexico to restore order, by aid of our moral support, backed by food and money, not by an army. All that we have a right to ask is that the Mexican government will observe its own constitution and laws; we should not try to impose our ideas of what is lawful; the restoration of order must be a domestic matter. Most of all, we must devise a stable policy, just as much as the Mexicans themselves.



Simp Spelling

The Editor:

Sir—I have received a communication from the Secretary of the Institute, presenting arguments prepared by one of the members, W. H. Shockley, in favor of certain so-called reforms in spelling, and also presenting the brief and sane reply of the president and board of directors against such reforms. My ballot has been forwarded, voting against the proposals.

Mr. Shockley and the spelling reformers mean well. Their avowed object is to "make our spelling conform better to the pronunciation"; meaning, one must assume, to the present pronunciation of our words. In this attempt they are committing a fundamental mistake, for pronunciation would prove an unstable foundation should it be made the basis of a reform in the spelling of our language.

(1) Pronunciation is not uniform. At the present time, words are not pronounced alike in different parts of the United States, nor in different counties of Great Britain (to say nothing of Ireland); not the same in Canada or in Australia. For example: 'Been' is pronounced *bean* in England, and *bin* in the United States. 'Can't', 'fast', 'last', 'half-past', 'worry', 'squirrel', are further illustrations.

(2) Pronunciation is unstable. As Mr. Shockley and the reformers state, the pronunciation of our words has changed in the past, and to my knowledge it is continuing to change at the present time. In New York for example, words, such as 'church', 'skirt', 'bird', 'hurt', 'Ernest', are usually pronounced *choich*, *boid* (*bowed* might be better), *skeet*, *ho-eet*, *Oee-nist*, by most New Yorkers. The usual pronunciation was formerly current in that city during my twenty years residence there. Contrast these with the sounds of the same words as pronounced in Scotland!

It is untrue to assert that "the spoken and not the written words constitute the language". Both constitute it, except among savage and ignorant races where writing and printing are unused. Latin, for example, is practically dead as a spoken language, except in the Catholic church; but it still exists in the form of innumerable books, documents, and inscriptions. The sounds of spoken words have an existence measurable in fractions of a second, and unless recorded (as by the phonograph), they cease to exist outside our memories. *Per contra*, written words have at least a visible and permanent existence.

Mr. Shockley rather praises our English language in

saying that it is the widest spoken of all. He advocates a "scientific spelling" to increase the spread of the language among foreign nations. It might accomplish that result; but the present limited spelling reform proposals are the reverse of scientific, proposing that we butcher only a score or so of words, as a beginning. Scientific reform of spelling would entail changes of a far-reaching and drastic character. For a scientific phonetic spelling we would first have to agree upon an accepted pronunciation for all our words—a difficulty indeed. The final result would be a language largely new; perhaps with forty letters in its alphabet. The vast collection of books in our public and family libraries would grow obsolete and unread excepting by those also educated in the present English language.

Even now attention is somewhat distracted when an American reads an average British publication, and the reverse; for the spelling reformers have already begun to confuse our common language. Let us beware of multiplied spelling creeping into further use under the alias of simplified spelling. If changes come, let them come by natural growth: the slower the better. The doubtful advantages offered by the small but noisy soviet of spelling reformers were well expressed to me a dozen years ago, by T. M. Hamilton, then superintendent of the Braden copper mine. He remarked: "I like this simplified spelling; you can spell any damn way you please."

Let us pray that our friends Shockley and Skeat will start to boom Esperanto, and let our language alone.

HAROLD ABBOT TITCOMB.

Farmington, Maine, January 5.

The Editor:

Sir—In the matter of 'simplified' (which I take to mean phonetic) spelling, it seems to me that there is an aspect more important than the mere change of orthography, and that is the effect such change would tend to have in crystallizing some special system of pronunciation; in short, the movement tends to reform not merely spelling but pronunciation. Not that a standardized pronunciation would be necessarily objectionable *per se*, but it does seem to me a grave objection that irresponsible individuals or societies should do the standardizing.

As an instance, take the word 'thot', which many (possibly including Mr. Shockley, I do not know) are trying to introduce in place of 'thought'. Now the sound almost universally attributed to the orthodox spelling, both in England and America, is 'hawt', which is not

the sound indicated by the spelling 'thot'; the latter word if pronounced strictly as written would be both provincial and cacophonous.

Another example of my contention may be taken from Mr. Shockley's own letter in your issue of January 10. He quotes with approval the word 'sulfid'; if this spelling is intended to be phonetic he evidently expects all of us to pronounce the word with a short 'i' in the last syllable, as in 'hid', but Webster's dictionary allows two pronunciations, and in my experience the one with the 'i' long, as in 'hide' is much more commonly used. Mr. Shockley may of course argue that 'sulphid' is more easily spoken than 'sulphide', though it is open to question whether the universal adoption of the former would not be a change for the worse, since the sound of the word 'sulphid' might easily be mistaken for 'sulphate'; but, in any case, the question is not of the desirability of a given pronunciation but of the right of 'simplified spellers' to dictate to us what intonations and vowel values we shall use in the spoken language.

Mr. Shockley's expression "amide the melting snows", which seems to have puzzled you, Sir, is I think an effort to throw derision on the accepted spelling of 'sulphide', which he appears to assume is, or ought to be, universally pronounced 'sulphid'.

Instances might be multiplied, but the two I have given are I think sufficient to show that the movement affects not only spelling but pronunciation also, and should be carefully watched.

E. M. HAMILTON.

San Francisco, January 16.

[No further letters on the subject will be accepted.—EDITOR.]

A Stable Government for Mexico

The Editor:

Sir—Mr. Blamey Stevens' recent letter¹ and articles² are of suggestive and permanent value for those interested in Mexico. With most of his ideas and statements I am in hearty agreement, and it is in a spirit of co-operation rather than of criticism that I offer the following addition to his remarks:

Mr. Stevens has made a good beginning in attacking the problem by the scientific method of facing the facts, whatever they may imply, and had our American statesmen of recent years done the same, Mexico would not now be in its present dreadful condition. A country's political institutions reflect the character of its population, which in the case of Mexico may be roughly divided into three classes: the whites, 10%; the Indians, 40%; and the *mezizos*—half-breeds sprung usually from Spanish fathers and Indian mothers—50%.

The whites born in Mexico are locally called creoles, and are preponderantly of Spanish descent. None but

Spaniards were allowed as immigrants during the Colonial period; and, since its close in 1810, English, French, Italian, German, and American residents of the country have been greater in influence than in numbers, as they have belonged almost entirely to the educated middle class. One can readily comprehend the political attributes of the Spanish creoles only after a careful perusal of the history of the Colonial period.³ No European born in Mexico was ever allowed to hold any office under the viceroy, whose bureaucracy was always imported direct from Spain. Thus the creoles had no chance to acquire any political training until they managed finally to overthrow the Spanish power in 1821. During the past century, the creoles more or less dominated the government since their superior education and intellectual inheritance more than offset their paucity in numbers. Yet starting with the medieval political theories and practices of the Spanish autocracy of the XVIII century, the creole politicians have hardly advanced at all since that time, and for two reasons: first, because of the perennial revolutions, due to the ignorance of the masses; and second, because of their own character, entirely lacking in the usual initiative and enterprise of Western Europeans. This lack may be scientifically explained by the theories of inheritance⁴ for during three centuries, from Ferdinand and Isabella to Napoleon's invasion, the Spanish Inquisition extirpated by dungeon, faggot, or exile every individual of nonconformist social and political tendencies born within the Spanish dominions.

Consider next the class of Indians of whom Mr. Stevens says: "That the Indians are capable of high standards of civilization under a monarchy is well proved by their history," and "When Cortez arrived in Mexico in the XVI century, he found the Aztecs had a stable government and that civilization had therefore made great progress among them." In these sentences, Mr. Stevens falls into the same error—also recently promulgated by no less a personage than John Lind⁵—as does W. H. Prescott in his romantic history⁶, when he calls the Aztecs "civilized". Modern archeology, anthropology, and ethnology have completely discredited the fanciful parallels drawn by the Spanish chroniclers of the Conquest between the political institutions of the Aztecs and those of medieval Spain. If we divide human progress into three epochs: Savagery, Barbarism, and Civilization, and subdivide each epoch into three stages: Lower, Middle, and Upper, the Aztecs must be located in the Middle stage of Barbarism according to D. H. Morgan,⁷ who spent a lifetime in the study of the American aborigines. As Cortez' compatriots had reached the Lower stage of Civilization—implying a phonetic alphabet and the knowledge of steel tools—they were thus several milleniums of culture in advance of their Mexican subjects, who were certainly

³'History of North America', by Hubert Howe Bancroft, Vols. on Mexico.

⁴'Natural Inheritance', by Francis Galton.

⁵'The People of Mexico', by John Lind.

⁶'Conquest of Mexico', by W. H. Prescott.

⁷'Ancient Society', by D. H. Morgan.

¹'The Mexican Problem', 'M. & S. P.', Aug. 30, 1919, p. 287.

²'A Stable Government for Mexico', 'M. & S. P.', Nov. 1, 1919, p. 640.

below the Homeric Greeks and perhaps below the Egyptians of the First dynasty of nearly 5000 B.C.*

As our own Iroquois Indians had reached the culmination of the Lower stage of Barbarism in the XVI century, their institutions should be paralleled with those of the Aztecs rather than any in Europe. The Aztec 'monarch' thus appears merely the supreme chief of a confederation, his "nobility" rank as sub-chiefs of the various fighting clans, and his "law courts" are only inter-tribal councils of old men and braves. Like all barbarians in the Middle stage or below, the Aztecs were organized on the basis of population instead of territory, as the national and individual ownership of rigidly fixed tracts of land does not appear till the next stage of culture. The Indian tribal organizations had indeed confederated into an Aztec "nation", but the latter was still so incoherent as to fall to pieces before the first attack of a few hundred European freebooters captained by Hernando Cortez. Steeped in the cannibalism, the human sacrifice, and the religious fanaticism peculiar to Barbarian culture, the Aztec national organization, in its first feeble beginnings at the Conquest, was dissolved by the invasion into its original tribal elements, and has never since been able to make a fresh start⁹.

Contrary to the popular impression, the Mexican Indians were not all reduced to slavery by the Conquerors. A large fraction were protected from further creole molestation by the Law of *Egidos*, decreed in 1573 by Philip II, which set aside hundreds of reservations (*egidos*) in all parts of Mexico for the perpetual and exclusive use of the Indian villagers who occupied them. Each *egido* comprised a small central *sitio* (townsite) for the dwellings, and this nominally had an area of one square league around it, but as the boundaries were merely fixed by natural landmarks the actual area was often much greater. Though the *egidos* were located on hilly, wooded, or semi-arid lands—as the best tracts of valley lands had already been appropriated by the Spanish colonists—they enabled the Indian villagers to gain the rude living to which they were accustomed, independent of creole oppression. On the *egidos* the Indians preserved most of their ancient tribal customs and government, merely altering their Aztec bloodthirsty cult to a mild but superstitious form of Catholicism. They apportioned their communal lands for cultivation, and protected life and property within the village under the leadership of elected *caciques* or 'judges' as of yore. They had little to do with any Europeans, beyond perhaps some wandering friar, who might conduct for awhile a church and school, and the traders in the nearest creole town. They still spoke their Indian dialects among themselves, and even now there are millions of villagers who know little or nothing of the Spanish language.

Quite different was the fate of the Indians who were unlucky enough to be enslaved by the creole colonists. Treated like domestic animals, except for a perfunctory

instruction in Catholic rites, they soon lost their former tribal morality; and little or no restriction being placed on the consumption of *pulque* (maguey beer) and alcohol, acquired the vices, without the virtues, of their masters. There is now probably no more degraded working class in the world than these millions of Indian peons, either on the great estates, or in the mining and industrial cities whence thousands have migrated since the building of railroads in the 'eighties. Usually liars, thieves, and drunkards, they can only be compared morally with our semi-criminal class or the lowest type of Southern plantation negro.¹⁰ Often a newly-arrived American *entrepreneur* has tried to treat these peons as he would his own countrymen, but he has always been shamelessly deceived and plundered as a consequence. Every Mexican factory or mine, where there is anything worth stealing, must maintain a watchman at the gate, to search every peon leaving the establishment after his day's work, or soon all movable chattels will have disappeared. It is only fair to the Spanish colonists, however, to state that this criminality of the peon is only partly their fault, for the latter's Indian ancestors deemed morality a tribal matter, and like most barbarians did not consider it a crime to deceive or rob strangers.

Outside of the *egido* villagers, most Indian peons have some white blood and are thus properly classed as *mestizos*; these comprise the bulk of the middle and upper classes. In Brazil there is much negro blood among the half-breeds, but the Mexican *mestizo* is practically a pure white-red mixture and partakes of the characteristics of both sides of his ancestry. More intellectual than the full-blood Indian, the *mestizo* reflects the idea and habits of his family's social class rather than those of either ancestral race.

During the Colonial period and outside of the *egidos*, Mexico was organized economically on the Spanish feudal basis. The agricultural land was divided into great estates owned by the descendants of Spanish colonists or by the religious orders, while the masses were serfs. Between the landlords and the serfs existed a small middle class who were merchants, officials, teachers, priests, and the like. In the mining industry were three similar classes, though here the vagaries of mineral deposition made the hereditary class lines much less rigid than in agriculture.

The coming of independence altered scarcely at all the economic organization of society. The chief difference was in the office-holders, who were now creoles or *mestizos* instead of Spaniards. The departure of the Spanish troops and the partial arming of the masses during the ten-year struggle for independence had augmented tremendously the bands of brigands, which even in quiet Colonial times had never been entirely suppressed by the viceroys. Mining sank forthwith into a half century of desuetude, and there ensued a continuous series of revolutions, which lasted till the 'eighties. By the Reform laws of 1857, the church lands were con-

*History of the World', by J. C. Ridpath. Vol. on Egypt and Greece.

⁹In Indian Mexico', by Frederick Starr.

¹⁰Mexico, the Land of Unrest', by Henry Baerlein.

fiscated by the national government, under General Comonfort and Benito Juarez, yet as they were sold for a song and usually fell undivided into the hands of rich merchants, many of them English or French, the change of ownership did nothing to disturb feudalism but merely transferred a third of all landed property from religious to secular control.

Porfirio Diaz, a Oaxaca Indian partly educated for the priesthood, had become a general of the Liberal party during the French intervention, yet was so unprincipled as to rebel against President Juarez in 1871 and against President Lerdo de Tejada in 1876. Successful in his second attempt at supreme power, he managed to retain it, by hook or crook, until the Madero revolution ejected him in 1911. Though always professing liberalism, as president he soon fell under the political control of the great landlords, and during his reign did nothing directly to disturb their system of peonage for debt, which had been prohibited by the Constitution of 1857, or their ever-growing monopoly of the national resources. To offset these shortcomings, Diaz had two great political virtues—a firm desire to enforce internal peace, and a cordial hospitality to foreign industrial enterprises. Through the latter policy he was able to achieve the former, which had baffled his predecessors; for with the network of railways, built by Americans during the 'eighties, he managed so to multiply the effectiveness of the Federal army and the State rural police that brigandage ceased to be either safe or profitable as an occupation.

Though Diaz accomplished little, except in the few large cities, to reduce the illiteracy of the peons—owing to lack of funds and the opposition of both landlords and clergy to education—his welcome to foreign business created a powerful leaven for their enlightenment. By working for an American mine or railway, the peon not only enjoyed higher wages than under his feudal masters but felt, for the first time, the stimulating and broadening effect of the free labor system. From his association with foreign foremen and artisans, he acquired, along with technical skill, an acquaintance with both political democracy and trade-unionism—a knowledge which had hitherto been confined in Mexico to the intellectuals. Moreover, under Diaz, there was a large relative increase of the middle class, for the free schools in the cities, although too few to lessen appreciably national illiteracy, were yet sufficient to endow many peon children with enough learning to qualify as clerks or petty officials.

As offsets to these benefits of the Diaz regime were some serious factors tending to social unrest. The bulk of the peons, still illegally chained for debt by the landlords as of yore, were becoming impatient of duress and longed to escape and to work as free laborers for the foreign enterprises, as so many of their relatives and friends had already done. Secondly, the *haciendas* (great estates) had become a serious impediment to further economic progress. In 1910 some 11,000 families owned 880,000 sq. km. of land or 44% of the national territory, and this property included the bulk of the best arable soil.¹¹ Through its control over Diaz, the landlord party

almost exempted the *haciendas* from taxation, by false assessments, and threw the growing burden of government either upon the foreign mining and industrial enterprises or upon the native masses. Most landlords held much of their good land idle, either for speculation or because too lazy to develop it; as a consequence the country was unable to feed itself a good part of the time and was saved from famine only by extensive importations of maize. The maguey-growing landlords, also, were responsible for the besotting of the peons of all the cities of the Central Plateau by *pulque* and alcohol, for they opposed any such restriction of the liquor traffic as is practised by other civilized governments.

Thirdly, the growing middle class with their half-baked knowledge began to be insanely jealous of their foreign rivals for employment with the numerous alien corporations, fancying that the preference enjoyed by the latter in place and pay was due to race favoritism and national prejudice rather than to superior ability and integrity. Many carried their envy so far as to become active partisans of the anti-foreign faction, which frankly proposed not only to prohibit further immigration but to expel all foreigners from the country, confiscate their property, and turn Mexico into a closed preserve for the *mezitizo* race.

Last, but not least, of social disturbers were the predatory elements in the foreign business invasion. The law of 1857, nationalizing church property, had also authorized the abolition of the *egidos*; but this unwise measure produced no marked bad effects till the advent of railways, in the 'eighties, made the Indian lands attractive to foreign speculators. Then, by conspiracy with corrupt native officials, these latter obtained from the Mexican Congress the *Deslinde* laws¹² of 1883 and 1894 which, under the guise of re-surveys and colonization, enabled the conspirators to obtain title to a large part of hundreds of *egidos* and evict their Indian owners. In this way, myriads of Indian villagers were deprived of their ancient communal lands and obliged to wander forth in search of employment as penniless peons. Meanwhile a few dozen land companies had gobbled up 10% of the whole country.

Such, in brief, was the condition of Mexico in her gay Centennial year of 1910, when Diaz finished his seventh presidential term after 34 years of power. In spite of the seething unrest, the coming revolution might even then have been avoided had the dictator been wise enough to retire in favor of some enlightened and progressive successor. But the aged autocrat yielded to the pleas of the corrupt ring of grafters—called popularly *cientificos*—under whose tutelage he had been for many years, and he not only had himself "re-elected", but also named as vice-president, and probable successor, the corrupt reactionary Ramon Corral. This error gave Francisco Madero his opportunity and, defying the feeble old

¹¹'El Latifundismo Mexicano', by R. B. Brinsmade, Libreria Bouret, Mexico City.

¹²'Leyes sobre Tierras de 1863 a 1912', Dept. of Fomento, Mexico City.

lion of Chapultepec, he raised the standard of revolt in the north and soon had the nation at his feet.

Successful as a revolutionary apostle, Madero entirely lacked the executive talent and constructive ability required at that time by the presidential office. Instead of correcting the crying economic wrongs of illegal peonage, unfair taxation, and the despoiled *ejidos*, he busied himself with "effective suffrage", an article which the average Mexican knew little about and cared even less. By 1913, when overthrown by the Huerta military conspiracy, Madero had lost his popularity and it was only by becoming a heroic martyr that his name was again enshrined in the hearts of the masses.¹³ The Centennial year was the end of the quarter-century of Porfirian peace, for brigandage then began to revive with the break-up of the rural police system and the encouragement given by the Madero party to every armed adherent, whatever his moral character or practice.

The problem of perennial brigandage is usually explained by considering the Mexican from the standpoint of the 'economic man' of the textbooks. Oppressed by his masters and having nothing to lose except his life, the peon takes to brigandage as a business proposition, where a lucky encounter may make his fortune. This sounds plausible, but in only a minority of the actual cases does it probably accord with the facts. While the bulk of the Indians were immobile agriculturists, and had thus outgrown the hunting stage of culture, on the advent of Europeans in 1521 there yet remained many backward tribes and numerous atavistic members of the advanced tribes who were still natural rovers. And such is still the condition after four centuries of Spanish domination. Scratch a bandit or 'revolutionist' and you often find, not a designing criminal, but a savage who prefers the wild life of the woods and hills, with all its uncertainties and hardships, to anything that can be offered of comfort or well-being within the necessary restrictions of civilized discipline. While the brigand for economic reasons may evidently be eliminated by abolishing class privileges and making honest industry more profitable than theft, the bandit of atavistic inheritance can only be suppressed by an adequate police force, and this simple fact, acted on by Diaz, has been disregarded by our Democratic doctrinaires in their writings about Mexico.

It is unnecessary to review here the disgraceful events that followed the triumph of the 'Constitutional' party in 1914 and the flight of the reactionary Huerta, as they have already been detailed in the 'Press' by its various correspondents, especially during 1916.¹⁴ Suffice it to say now that the victors split at once into several contending factions and after a series of bloody battles in the spring of 1915 around Celaya, the Carranzistas overcame their chief opponents, the Villistas, and have ever since dominated the chief cities and their connecting railways. Instead of restoring the Constitution of 1857, for which they had ostensibly fought Huerta, the Carranz-

istas, after their enemy's flight to Europe, proceeded to suspend the Constitution for an indefinite period. This 'Pre-Constitutional' interim lasted from September 1914 till the inauguration of the new or Carranzista 'constitution' in May 1917, which was a document entirely unconnected with the former constitution and therefore by its criterion quite unconstitutional. However, this lawless interim served its projected purpose well, for it effectually shielded from any future legal reckoning the countless crimes committed by most of the Carranzista leaders between 1914 and 1917. Among these crimes, the repudiation of \$1,250,000,000 paper money in 1916, and the looting of the banks of issue shortly after, were only nation-wide examples of the shameless greed and chicanery that devastated every locality visited by the self-styled reformers, who, like a flight of human locusts, caused the deaths of myriads of Mexicans from famine and hunger-typhus.

Were Mexico a hermit empire, like the Japan of 1850, her present political and economic condition, however distressing for her people, might be of intense interest to historians but to few other foreigners. Unfortunately for the outside world, Mexico ceased to be a hermit State in 1821; and, by 1910, her policy of advertising for and welcoming the investment of foreign capital had resulted in her absorption of nearly two billion dollars of alien cash, of which over one-half came from the United States. Along with the capital had come a large number of high-grade immigrants to look after its management and make their homes in the country. The present revolution, which has now lasted for nine years, has destroyed or rendered unproductive from inaction the greater part of this foreign capital, and has compelled the repatriation of most of its foreign guardians and attachés for lack of means of livelihood.

The dictatorship of Diaz, however unsatisfactory from many standpoints, was at least friendly to foreigners and kept faith with its creditors, as is proved by its high standing in the international money market. After nine years of disorder, urban Mexico now finds herself under the dictatorship of Carranza, which is unfriendly to foreigners and has no international credit at all. Yet the Carranzista policy is probably more representative of Mexico than was that of Diaz, for the majority of literate Mexicans—the only kind that counts politically—are jealous of foreigners and so dishonest in commercial transactions that most large business operations, which require credit, are necessarily conducted by aliens.

Practically, if not nominally,¹⁵ an international outlaw, Mexico can only resume her former position as a decent member of the family of nations by accomplishing three things: first, the suppression of the brigandage which now renders unsafe, in most parts of rural Mexico, the operation of foreign mines, railways, plantations, and factories; second, the payment of the coupons of the bonds of the national debt and railways, in default since

¹³ 'Political Shame of Mexico', by Bell.

¹⁴ 'M. & S. P.', Vol. 112, pp. 175, 525, 873; Vol. 113, pp. 88, 155, 605, 874.

¹⁵ The Carranza government has been recognized by the United States as 'de jure', but not by England, France, or the League of Nations.

1913; third, the satisfaction of all claims by foreigners, for loss of life or property during the present revolution, which are recognized as legitimate by international law. That the Carranza government is capable or even desirous of achieving these objects is much less probable than the birth of white elephants in Siam, if anything can be predicated from its record during five years of power. And even less can be hoped from its rivals, the Villistas, the Felicistas, the Oaxaqueños, and the Zapatistas, even though the latter factions succeeded recently in hoodwinking the adventurous Mr. Gates.¹⁷

Being thus forced by the outstanding facts to adopt Mr. Stevens' conclusions that foreign intervention is necessary if Mexico is to be pacified and restored to international decency, we can next proceed to examine his practical proposals for its accomplishment. In his first article, he suggests methods for an intervention by the League of Nations, and in his second, he demonstrates clearly from history, a subject too often ignored by radical doctrinaires, that a democratic form of government will only suit a nation that has become sufficiently developed politically to understand and operate it. As a large majority of the Mexican people is still living in the Barbarian stage of culture, it is highly misleading to compare its "revolutions" with those of modern France, as superficial native and even foreign writers are fond of doing, for those of Hayti¹⁸ are much closer in kind. A foreign intervention will not therefore be a peaceful relief expedition, as Mr. Stevens seems to imply, but an armed invasion able and willing to overcome the resistance that must be expected from the native faction in power at the time.

During the intervention, no aid should be requested from any of the factional chiefs, whether civil or military, for nearly all are hypocritical and untrustworthy. When Mr. Stevens remarks: "Among Mexicans who can read and write, the average standard of education and culture is probably higher than that obtaining in the United States," he may be correct in that the book knowledge of the 10% of literate Mexicans exceeds the average requirements of the 90% of literate Americans. Nevertheless he gives a false impression, for the chief requirement for his proposed Supreme Court to control elections would be moral character rather than book knowledge, and in this quality the Mexicans would stand far behind the Americans. If Mexico had possessed any such clan of patriotic, brave, and unselfish leaders as the Samurai of Japan, she would long ago have attained to a stable civilized government in spite of her barbarous masses. While a few score men may be found among the 12 millions of Mexicans who measure up to the moral code of the Samurai in their individual practice, they are passively rather than actively virtuous, and, lacking completely the faculty for organization, they are helpless to oppose the political schemes of the numerous and

cunning demagogues, backed as the latter are by hosts of armed brigands. It is safe to say that these chosen few can never make their uplifting influence felt in the Mexican government until supported by foreign troops.

While a foreign intervention should naturally be made in the interest of the millions of peaceful Mexicans—the innocent and otherwise hopeless victims of the brigand political factions—as well as for the enforcement of treaty obligations, it seems both useless and rash to precede it by the lengthy investigations and elaborate diplomatic and military preparations suggested by Mr. Stevens. The few high-minded natives, whose advice might be valuable, could not be reached by the investigators, for they are not in exile but are living in retirement in the interior; while the longer notice the brigand-factions have of the proposed invasion the worse it will be for both their local victims and the invading army. On this basis, the seven procedures of Mr. Stevens' plan can be easily condensed into the two following: First, after due notice of intention let the mandatory of the League of Nations blockade all Mexican ports and invade the country, from several points simultaneously, with an overwhelming force so as to minimize the bloodshed of capture; second, as soon as organized resistance ceases, form a civil government modeled after the first American structure in the Philippines, with its provisions for universal compulsory education, for a rural constabulary, and for the filling of all possible public offices with qualified natives.¹⁹

Both before and after the intervention, the mandatory nation should seek the co-operation of all patriotic intellectual Mexicans in explaining to the ignorant masses that no suppression of their nationality is either proposed or desired, but that the main object of the new government will be to protect them against further depredations of their own criminal elements until they can become sufficiently educated to know how to protect themselves. How long this educational process must last before Mexico can be safely released from tutelage can only be surmised, but judging from our similar experience in the Philippines—whose population²⁰ is close to the cultural status of the Mexican—it may require a generation or more.²¹ However that may be, I must disagree with Mr. Stevens when he says, "Education must be along the best ideals of Mexican national life and not the ready-made system of the United States or any other country." Does Mr. Stevens here refer to the ideals of the Aztec barbarians or to those of the Spanish exploiters of the Colonial period, for these are certainly the only ones poor Mexico has by national inheritance? To achieve its object must not the new educational system be based on an entirely different set of ideals from either of these?

RESIDENT OBSERVER.

Mexico City, December 16.

¹⁷'Four Governments of Mexico', by Wm. Gates in 'The World's Work', March and June 1919.

¹⁸'The Revolution in Hayti and Santo Domingo', by Stoddard.

¹⁹'Code for Civil Government in Philippine Islands', 1901. U. S. Supt. of Documents, Washington, D. C.

²⁰'Ten Years in the Philippines', by Dean Worcester.

²¹'From Order to Chaos in the Philippines', 'Saturday Evening Post', July 12, 1919.

Elements of Smelting-Plant Design—I

By OLIVER E. JAGER

INTRODUCTION. This article is intended for younger members of the profession, and is an attempt to explain the method of selecting some of the appliances usually found on a modern smelter, as well as to discuss pertinent generalities. A book could be written on smelter-design, and it is reasonable to suppose that some engineer who has specialized in this particular branch—such as, for example, A. G. McGregor—will eventually make this much-needed addition to technical literature. In an article of this nature the treatment of the subject will necessarily be sketchy, as many of the problems are presented as they have occurred in practice, some being answers to questions asked by young engineers when starting work at a smelter. Only the metallurgical side of the subject will be treated, with brief reference to cognate subjects.

In considering equipment in general, it is well to remember that, with a few notable exceptions—such as, for example, the Dwight-Lloyd sintering machine and the Cottrell dust-precipitation apparatus—the principal appliances in a copper or lead smelter have been borrowed and adapted from the metallurgy of iron. For this reason, it is my opinion that a visit to a steel-plant is always worth while, as it is seldom that one comes away without having picked up some detail about machinery or method to repay the trouble of the visit. One noticeable feature—worthy of emulation—is that everything about a steel-plant is doing work and getting results. Whether the steel-men (like the medical profession) bury their mistakes, I do not know, but it is a fact that, on a steel-plant, one seldom sees any of those monumental junk-piles or rusted and un-used aggregations of machinery that are often noticed at a copper or lead smelter, especially in isolated localities, where one would think standard equipment would be used, and not the new patent process invented by a retired grocer, or the wondrous machine conceived in the brain of some clever inventor who never worked a smelting-furnace.

SIZE OF PLANT. Let us now take an imaginary case of a copper smelter with a daily capacity of 1000 tons of ore, to serve as a framework on which to hang these notes. The first question that may be asked is why this particular capacity was selected by the designers. To answer this one must go to the financial side of the case, and it may be as well to emphasize here that, in the last analysis, metallurgy is a matter of dollars and cents. The primary object of every manufacturing process is to make money. If a smelting-works (which is really a factory) produces bullion with a market-value of \$200 per ton, but which costs \$220 per ton to produce, it is only a question of time until the concern goes bankrupt. It makes no difference how pretty a process may be

chemically, or how skilfully it be applied, if the resulting product cannot be disposed of at a profit, the process is a failure. This sounds like a truism, but it is surprising how often it is disregarded.

Assuming that the smelter is to treat the entire daily production of the mine, the size of the plant is thus regulated. This production, however, must be at a rate such as to pay interest on the capital invested and provide amortization for the plant. If the production is too low, no profit at all will be made. While increased output does not mean a proportionately increased operating expense, since fixed charges remain more or less constant, it is possible to have production too high; that is to say, there will be so great an expenditure on plant to handle the large tonnage, that any saving on fixed charges becomes doubtful, or may even become negative and result in a loss.¹ A certain relation between ore-reserves and treatment-capacity must be observed, hence the plant should not be too large for the amount of ore developed, as a plant not operated to capacity is not being operated economically. When machines and appliances are lying idle they are returning no interest on the money invested in them. It would seem almost unnecessary to add that a treatment-plant should not be erected until a sufficient tonnage of ore has been actually developed to warrant the investment, were it not for the fact that the neglect of this precaution has been the cause of much loss in the mining business. In other words, there must not be a smelter before there is a mine.

Regarding the amount of capital invested, it is well to remember that this must be sufficient not only for the necessary purchase of property and equipment, but also to provide enough money to carry on operations until the product is on the market, as it is only then that returns will commence. This question of the time that elapses between the mining of the ore and the marketing of the final product is a very important one. That it is frequently overlooked is also true. For the enterprise to be successful, whatever capital is invested must be repaid, with interest, before the business is wound up, which brings us to the consideration of amortization.

Amortization is the redemption of capital by annual payments to a fund set aside for the purpose. This fund is independent of dividends and is arranged to re-pay the original investment at the end of a certain period of years. The fund is put out at compound interest, or invested in some form of easily-realizable security, so that the total to be set aside will be less than the amount invested.² A plant may be regarded as a tool for perform-

¹H. C. Hoover. 'Principles of Mining'; chap. 15.

²Hoover, op. cit., chap. 5; also Finlay, 'Cost of Mining'; chap. 3.

ing certain work. When the work is completed, the tool may or may not be serviceable for other work; it is safer to assume that it will not. A smelting-works is a collection of appliances for treating ore. When the ore is all treated, that is, when the mine is exhausted, the purpose for which the plant was erected has been attained, and it may then be regarded as a collection of second-hand machinery, a great deal of which could neither be realized upon nor removed. In practice this state of affairs rarely obtains, as a progressive company with a good plant is on the look-out for new supplies of ore long before the original mine has become depleted. In any case the cost of the plant must be defrayed out of the profit made by it; hence the application of amortization to it. This re-payment is often called 'depreciation', especially by writers on accounting, who will 'amortize' a bond-issue, but 'depreciate' a plant.³ This apparent confusion of terms is probably due to the fact that the usual meaning of the verb 'depreciate' is 'to become of less value'. If a new plant is worth \$1,000,000, it may be assumed to be worth, say, \$900,000 at the end of a year; that is, it has 'depreciated' in value. While this is true enough, any sum written off for the re-payment of the cost of the plant is really an amortization charge, though one frequently finds depreciation used in this sense. Finlay⁴ regards depreciation as nothing more than maintenance, or current construction and improvements. Whatever nomenclature is adopted, charges for maintenance of the plant and for the re-payment of its cost should be included as part of the operating expense.

In the preliminary estimation of operating cost, a charge must be made for amortization, as it may be found that, on account of this charge, it would be more profitable to send the ore to a custom smelter than to erect a new plant to treat it. The rate of amortization usually adopted in preliminary estimates is 10%. This does not mean that the business will be wound up in 10 years, nor that the plant will be worn out in that time, though furnaces and other appliances subject to hard usage are not good for much more. It must be borne in mind also that improvements in metallurgy are constantly being introduced, so that a plant that is modern today may be out of date ten years hence. The preliminary calculation for the amortization charge per ton is made as follows: Suppose a plant of 365,000 tons annual capacity cost \$1,825,000 and that it will have a life of 10 years; then

$$\frac{1,825,000}{10 \times 365,000} = 50 \text{ cents per ton of ore treated.}$$

This is the same as saying that if a plant cost \$5 per ton of annual capacity, the amortization charge per ton treated will be 10% of this sum. To obtain accurate cost-data on operation, this 50c. should be distributed among the various departments—blast-furnaces, converters, reverberatories, etc.—on the basis of tonnage of ore or matte treated, with due consideration of the probable life of each group of appliances.⁵

To sum up: Money must flow into the treasury at a

³R. H. Montgomery. 'Auditing—Theory and Practice.'

⁴Loc. cit.

⁵Herbert Haas. 'E. & M. J.'; Feb. 19, 1910.

certain rate. As this money comes from the sale of copper and contained precious metals (if any), a certain tonnage of product must be shipped each month from the smelter. While the mine output, and hence the capacity of the plant, are thus theoretically determined, in practice there is always a certain amount of leeway, since allowance must be made for various contingencies, such as variation in metal-prices, change in grade or character of ore, necessary repairs to furnaces, etc. For this reason a small proportion of extra plant is generally provided. That is to say, to ensure the continuous treatment of 1000 tons per day, the plant should be capable of treating in the neighborhood of 1150 tons. This does not conflict with what was said previously about idle plant, as the maintenance of a steady output will more than offset the loss of interest, provided, of course, that the number of extra units be not excessive. Finally, emphasis must be laid on the fact that it is impossible to extract 100% of the metal-values of an ore. Proper allowance must be made for this when figuring the tonnage of ore necessary to yield the required output.

LOCAL CONDITIONS. In the first place, these are of importance in deciding where the plant shall be situated. Since the mine is a fixture, it must be determined whether it is better to place the smelter near the mine, or to erect it at some more or less distant point and haul the ore to it. This would mean a consideration of the railroad facilities already existing, or of the construction and operation of a new line of railway. An alternative would be to employ motor-traction and allow for the maintenance of roads. The question of getting fuel and supplies to the smelter must also be considered; so that, so far as transportation is concerned, the matter resolves itself into the selection of a scheme involving the fewest total ton-miles, or, more correctly, the least amount to be paid out in freight, taking into consideration all incoming and outgoing material. Unfortunately, transportation is not the only factor in the case, as the questions of water-supply, proximity to farm-land, and suitable site for the smelter often take precedence. With the development of the Cottrell process, the business of 'smoke-farming' is not nearly so lucrative as formerly, although the question of smoke may have a bearing on the case if the expenditure for a fume-precipitation plant is not desirable. An adequate water-supply is of prime importance, although this must not be taken to mean that water-recovery schemes are not efficacious. Many plants are able to operate solely because of a well-designed equipment enabling them to use the same water (or a good proportion of it) over and over again. Regarding the plant-site itself, nothing need be said here, as the various advantages and disadvantages of hill-side, sloping, and level sites, as well as the consideration of the nature of the ground for supporting buildings, have all been treated in text-books.

In passing, it may be mentioned that there are two items to which sufficient attention is not always given: Provision for future enlargement of the plant, and suitable facility for the disposal of slag. The question of

power often has considerable influence on the choice of a site, as proximity to a source of cheap power is a desideratum of no mean importance. Labor is another factor that must be considered, both as to quality and quantity available at the existing wage-scale in the district. The geographical position of a plant often affects the supply of labor, as men have a tendency to gravitate toward towns and to avoid isolated localities. To hold men in outlying settlements, considerable attention must be given to housing, food, and opportunities for recreation. In foreign countries, local politics may enter into the matter, as well as the question of the distance from

charge under reducing conditions. Accurate data on sintering can be obtained by making tests in a pot of about 10 in. diameter, provided with a grate to support a few pounds of the ore or mixture under examination. A tight-fitting top is clamped on the pot, and a light blast of air introduced above the charge, which is ignited with straw or shavings. The results so obtained can be reproduced closely on the sintering machine. There would be little use, however, in fusing a heavy sulphide ore in the muffle, as the oxidizing conditions of the pyritic or semi-pyritic blast-furnace would be absent. Sizing-tests, with assays, are useful in showing whether

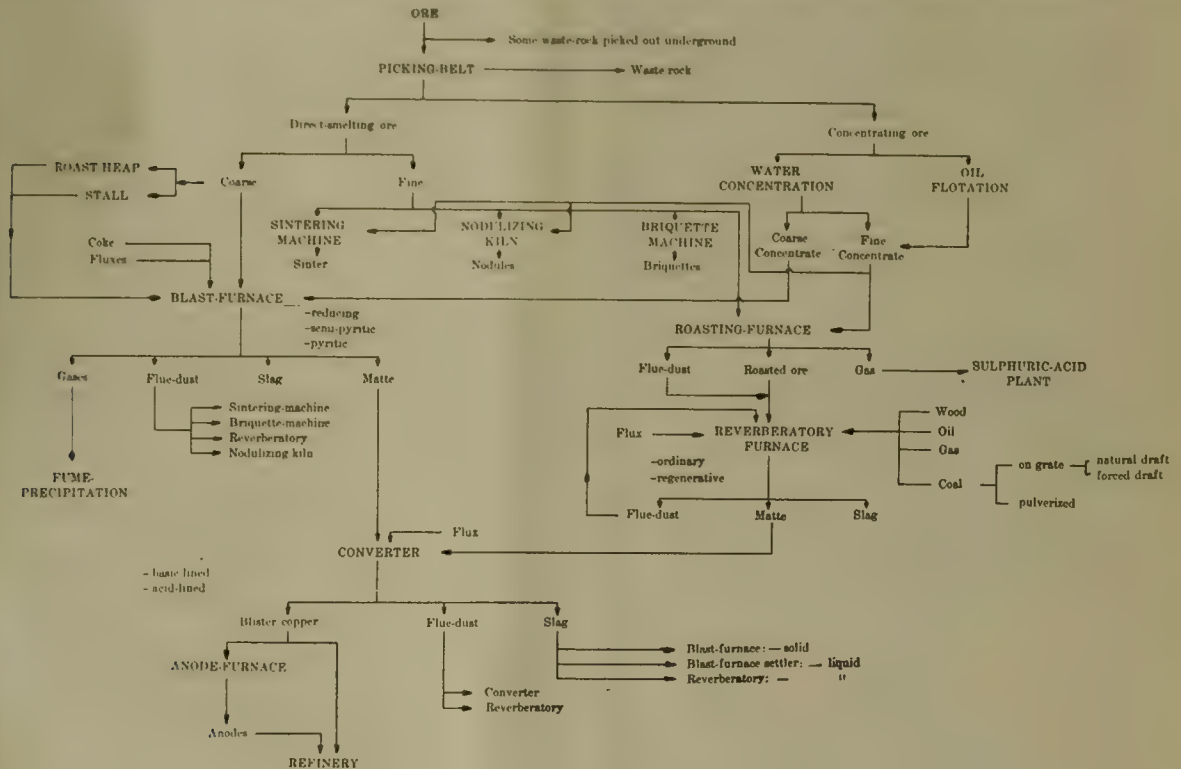


TABLE I. PROCESS OF TREATMENT

the market where the product is sold, and where fuel and supplies may be purchased. In general, local conditions may be divided into two classes: Those pertaining to technical matters, and those into which the human element enters.

SELECTION OF THE PROCESS. This is a wide question and has been taken up in various text-books.⁶ It is true, it does not always receive proper consideration by those contemplating the erection of a plant. Actual furnace tests of an ore are not often made, and if made on a small scale, the results are apt to be misleading unless carefully interpreted. Laboratory tests are of value if they correspond to large-scale operations, as, for example, in the case of an oxidizing roast. To mention other cases: By means of fusions in charcoal-covered crucibles in a muffle with a reducing atmosphere, considerable information may be obtained about the behavior of a blast-furnace

the metals occur in the coarse or in the fine portion of the ore.

In practice one is guided to a certain extent by what other operators in the same district are doing, or by the similarity of the ore to some other ore for which a successful process of treatment has been worked out, always bearing in mind the possibilities of improvement or the particular application under local conditions. All information bearing on the mine and the district should be studied; and, while 'do your own thinking' is a good motto, it should be remembered that, when approaching a new problem, the first thing is to find out what work other people have already done on it. This may mean spending some time with an engineering index looking up references at some technical library. Geological Sur-

⁶Peters, 'Modern Copper Smelting'; Barr, 'Testing for Metallurgical Processes'.

vey publications and maps, bulletins of the Bureau of Mines, and the technical press in general, are the usual sources of information.

The nature of the ore must be fully determined, so that it can be stated that it is, let us say, a mixture of various sulphides in a certain gangue. The problem may not be so simple, as it may be found that the mine contains two or more different classes of ore which must be regarded as separate constituents of a furnace-charge, or which will require separate schemes of treatment. Complete analyses of samples from the several orebodies would, of course, be made, and these should be supplemented by a mineralogical analysis for determining the proportion of each mineral present in the ore. Among other things, this is useful in showing how the ore would concentrate, and how the various metals occur in it. The method of doing this has already been published by Larison,⁷ and Sale illustrates the use to which the information is put.⁸ Should such an examination not be possible, the proportion of each mineral present may be calculated approximately from the complete analysis of the ore, providing the various minerals and the gangue have been identified. In most cases it would be sufficient to divide the ore under examination into useful minerals and gangue, as will now be illustrated by applying the method to the Sudbury nickel ore. These notable ore deposits have been fully investigated, so that there is plenty of available information about the minerals present, the mode of occurrence of the copper and nickel, and the nature of the gangue.⁹ Briefly, the ore is a mixture of chalcopyrite and pyrrhotite in a norite gangue, the nickel being present as pentlandite associated with the pyrrhotite. While the composition of the ore varies at different mines, the following analysis will serve the present purpose.

	%		%
Ni	2.3	SiO ₂	26.8
Cu	1.9	CaO	3.4
Fe	29.1	MgO	4.2
S	17.2		
Al ₂ O ₃	9.0		93.9
		K, Na, O (not determined)	6.1

Calculation of sulphides present: Pentlandite is of too uncertain a composition to be represented exactly by the formula (FeNi)S, but an average analysis compiled from Coleman's figures gives: Ni, 35.6%; Fe, 30.6%; S, 33.8%.

Chalcopyrite, $\text{CuFeS}_2 = 64 + 56 + 64 = 184$

Pyrrhotite, $\text{Fe}_7\text{S}_8 = 448 + 288 = 736$

Applying these figures to the analysis we get:

	Sulphide	Fe %	S %
2.3% Ni represents $\frac{2.3}{35.6\%}$	or 6.46% pentlandite containing	1.98	2.18
1.9% Cu " $\frac{1.9 \times 1.9}{64}$	or 5.46% chalcopyrite	1.66	1.90
	33.53% pyrrhotite	20.41	13.12
	45.45	24.05	17.20

There being no other sulphides present, all the sulphur (17.2%) must be accounted for here; therefore 17.2 - (2.18 + 1.9) or 13.12 = sulphur in pyrrhotite, from

which the corresponding iron and the amount of mineral are calculated.

The sulphides amount to 45.45% of the ore, therefore there is 54.55% of gangue. The gangue consists of various silicates composing the minerals of the rock norite, a basic rock containing plagioclase feldspar and pyroxene. Kemp defines it as gabbro with hypersthene instead of augite.¹⁰ From the formulas of these minerals we find that, metallurgically speaking, they are mostly bi-silicates and mono-silicates. The following table shows the combination of the elements in the gangue according to their silicate-degrees.

	Original %	Percentage of gangue	Base Silica Silicate
SiO ₂	26.8	49.12	
Fe	5.05	9.26	
		(11.90 FeO)FeO.SiO ₂ .11.90 + 9.92 = 21.82	
Al ₂ O ₃ ...	9.0	16.50	2Al ₂ O ₃ .3SiO ₂ .....18.50 + 14.56 = 31.06
CaO	3.4	6.23	2CaO.SiO ₂ 6.23 + 3.34 = 9.57
MgO ...	4.2	7.70	MgO.SiO ₂ 7.70 + 11.55 = 19.25
Na,K,O ...	6.1	11.19	2(NaK) ₂ O.3SiO ₂ 8.55 + 9.87 = 18.42
	54.55	100.00	49.24 100.12
Explanations:			
		Fe in gangue = 29.1 - 24.05 = 5.05	
		O with Fe = 11.90 - 9.26 = 2.64	
		(NaK) ₂ O = 11.19 - 2.64 = 8.55	

The alkali metals not being separately determined, we will assume them to be present in equal proportions, and give (NaK) an average combining-weight of 31.

From this mineralogical analysis we make the following deductions: 45.45% of the ore consists of heavy sulphides, and practically all the easily fusible material in the ore is contained in this portion. If this ore were subjected to an ordinary gravity concentration, the ratio of concentration would be but $\frac{100}{45.45}$, or 2.2:1 (assuming 100% recovery), and the concentrate would be a mass of sulphides high in iron. The analysis of the concentrate would be as follows: Fe, 52.9%; S, 37.8%; Ni, 5.1%; Cu, 4.2%. Nothing would be accomplished by such a procedure, as silica would have to be added again for fluxing. It would be highly advantageous, however, if some selective concentrating-method could be applied, so that the proportion of copper and nickel could be increased, and that of the diluting iron-sulphide diminished. There is no free silica present. Although the gangue contains 49.12% silica, it is not available as a flux, since the whole of it is already in the combined state, a condition frequently encountered in the Sudbury ore; though blebs of quartz are sometimes found scattered through it. This lack of free silica, together with the somewhat large amount of alumina, has been advanced as a reason for the failure to smelt the Sudbury ore pyritically. It may be mentioned in passing, however, that this ore has a certain amount of fluxing power when used in the converter, the explanation presumably being that the silicates are decomposed and a silicate of lower degree formed. A certain amount of iron oxide may also be dissolved in the fused silicate and thus carried out in the converter slag.

Returning to the general plan; the ore, or a portion of it, may or may not require concentration. Omitting this from consideration and confining our attention to

⁷E. L. Larison, 'E. & M. J.', May 2, 1914.

⁸A. J. Sale, *ibid*, July 8, 1916.

⁹A. P. Coleman, Bull. 170, Dept. of Mines, Canada; Report of the Royal Ontario Nickel Commission, 1917.

¹⁰Peele, 'Mining Engineer's Handbook'; p. 76.

fire metallurgy, we find that the method of treating a copper ore lies within somewhat narrow limits. The old division of the ore into coarse and fine, treating the former in the blast-furnace and the latter in the reverberatory, still holds good in the majority of cases. It is true that there are more modifications of this rule than formerly, principally owing to the development of the reverberatory furnace, as it may be found more profitable—again the money-question—to crush coarse ore and smelt everything in the reverberatory, than to maintain blast-furnaces to treat the coarse material. The reverse condition would be a plant containing blast-furnaces only, in which case the fine ore would have to be agglomerated by some process before smelting. Certain ores, of course, are better adapted to the blast-furnace than to the reverberatory.¹¹ An interesting example of the selection of blast-furnaces for a smelting works treating concentrate, with the reasons for doing so, is to be found in an article entitled 'Metallurgical Operations at the Braden Copper Co.', by R. E. Douglass and B. T. Colley.¹² This article shows not only how local conditions may affect the selection of appliances, but also illustrates how a process may suffer modifications as new conditions arise.

In every case the process must be so adapted to the ore that the greatest possible profit results. This requires the consideration of the cost of everything entering into the process, and the probable results that will be obtained from the use of it. The accompanying tabulation is intended to supplement the explanations found in textbooks, and, while admittedly capable of enlargement, gives an outline of the usual stages of treatment of a copper ore. It is not a flow-sheet, but is intended to show the various available methods of treatment, from which, by proper selection and combination, a suitable process may be worked out. Oxidized ores have not been included.

SMELTING THE ORE. The consideration of the results obtained by various methods of smelting being a prime necessity in selecting the process, it will be taken up under this heading, although it is really a part of the preceding section. To exemplify the fundamental principles, we will assume that (for some reason) a reverberatory plant is not feasible, so that a combination of blast-furnaces and sintering-machines has to be considered for smelting the ore. While what follows is used here for the purpose of illustration, it must be understood that, in actual practice, preliminary estimates of all possible methods and combinations, with the probable cost and the resulting production, are worked out for comparison. To do this successfully requires experience, judgment, and imagination, since the estimator must be able to form a mental picture of all the details of the process in order that no necessary step, machine, or man be omitted. An excellent example of this class of work is to be found in an article entitled 'Blast-Furnace v. Reverberatory', by B. Magnus.¹³

(To be continued)

Labor Unrest in South Africa

Direct testimony to the fact that 'labor unrest' is not confined to our own country or even to the white race, is contained in a review of the native labor situation by Col. C. W. Villiers, chairman of the Native Recruiting Corporation, Ltd., of South Africa, as reported in a recent issue of the 'South African Mining & Engineering Journal', of Johannesburg, from which the following is quoted.

There has been evidence during the year of a certain amount of unrest among the natives, both in the mines and among those in other employ, and this was on the point of developing when during the months of March and April serious trouble arose among natives employed on other than mine work in the various municipalities on the Witwatersrand. This trouble arose through a desire by natives for a general increase in wages, and was instigated by educated natives, who professed to be the leaders and representatives of the native workers. These self-appointed leaders of the natives had, since July 1918, been agitating for a general increase in native wages, and finding themselves unable to bring this about in any direct manner they advised all natives to return their passes to the Government offices, and to decline to take out fresh ones. On March 19, just prior to these agitations taking any concrete form, the Johannesburg branch of the Transvaal native congress wrote a letter to this corporation, requesting an interview on behalf of native workers for increased wages in the mines. Anticipating trouble, it was deemed advisable to send for representative native chiefs and headmen from various parts of British South Africa, for the purpose of preventing the spread of any influence the members of this native congress might bring to bear on the native workers at the mines.

A very representative gathering of native chiefs in Johannesburg was the result, and the presence of these real representatives of the natives no doubt went a long way toward preventing the disaffection spreading to the natives on the mines. The disaffection in the municipalities was accompanied by serious rioting, and many collisions with the police. The action of the corporation in sending for the native chiefs to come to Johannesburg was very strongly resented by the members of the Johannesburg branch of the Transvaal native congress. Mr. Taberer, the general manager, considered it advisable to endeavor to have a private meeting with the latter body, which he accordingly arranged, and held on April 29. Mr. Taberer was able to bring reason to bear on the members of the congress, some of whom, from their speeches, made it very clear that they were preparing for serious trouble, and from the date of the holding of the meeting the natives ceased to openly refuse to take out or carry passes. It is understood that full investigation is being made by the Government into the general question of the 'pass laws', with a view to the amelioration of any hardships under which the natives may be laboring.

¹¹Peters, op. cit.

¹²E. & M. J., Feb. 12, 1916.

¹³E. & M. J., Oct. 7, 1916.

The Mining Industry in Australia

By F. H. BATHURST

Early in the War there was given in this journal an outline of the manner in which certain groups in Australia were eliminated as the result of the attempt of Mr. Hughes, the present Prime Minister of the Commonwealth of Australia—then its Attorney-General in the Labor Ministry—to destroy the dominance that the houses of Merton of Frankfort, Beer Sondheimer, Aron Hirsch, and other German metal merchants exercised over the metal trade of this country. At first the attitude of Mr. Hughes was resented by Australian mining men who had been associated in one way or another with these alien dealers, not because they wished to conserve alien interests, but because they were suspicious of the political motives underlying the vigorous campaign that Mr. Hughes launched against the enemy firms.

The task of carrying out the Government's policy was entrusted to Mr., now Sir, J. M. Higgins. It is too soon after the War to discern all the motives that actuated a certain course of action at that time. The Labor party, which at that time stood solidly behind Mr. Hughes in his anti-German crusade, had visions of bringing about the nationalization of the base-metal industry of Australia. So it stands to the credit of Higgins that while striving for control by the State of this vital wartime industry, he evolved an instrument that enabled that control to be exercised without creating a Government department or bringing nationalization one whit nearer. The scheme in all probability did not work quite as Higgins expected. The creating of the Metal Exchange and the establishment of a system of registration of sales and contracts enabled the Government to block German attempts to retain its hold on industry through indirect means, and also prevented other countries from stepping into the shoes of the German metal firms. It also stimulated the enlargement or building of plants for the smelting and refining of base metals in Australia. These became a boon to the producers of lead, copper, and tin when high shipping-freights prohibited the export of anything save the refined metals. The British government also was put in the position of being able to purchase *en bloc* the exportable surplus of lead and copper, as well as of wolfram and molybdenite, and so could counter to some extent the moves of other countries to squeeze the last cent out of it for metals. But control did not pass entirely out of the hands of the Government into those of the Metal Exchange, and consequently the evils of political and bureaucratic interference still remained, although they were not as prominent as in other directions, especially in the matter of fresh issues of capital, to which reference will be made in another paragraph.

The reason of this inability to realize the idea of the

self-control of industry was primarily owing to a mutual distrust of the various mining groups of one another. They were not prepared, when they had the chance so to do, to leave themselves in their own hands. Whereas they could at the outset have rid themselves through the Metal Exchange of Government control almost entirely, rather than put themselves at the mercy of one another, they preferred to invite political and bureaucratic exploitation. Another reason was, as must always happen in any democratic form of government, that the power went to the stronger group or groups; the smaller producers, whose petty jealousies prevented them from organizing, failed to take any means to prevent being outweighed, although all the time they were most vociferous in complaining against exploitation by the more powerful groups that had come together. The outcry gave the politicians an opportunity to claim the right of interference. This tended to make the small producers the instrument by which some of the middlemen, who found themselves cut out of the trade by the co-operative selling organizations formed under the aegis of the Metal Exchange, attempted to work their way back. Finally, it is not assured that Higgins, although he created the Metal Exchange to avoid political and bureaucratic control, was prepared himself to hand over completely the power he was wielding as Government adviser to the instrument that he had framed. Still, the Metals Exchange did good work during the War, and if the Government withdraws its support from it now that hostilities are over there is every probability that some of the leaders among the mining companies will continue to associate themselves with it.

Another public part played by one or two leading citizens was to control, under the Federal Treasury, the issues of fresh capital. These gentlemen may have had something to do in the way of advising the Government in its price-fixing campaign. So far their recommendations and energies have not been fully disclosed, but the folly of interfering with industries, even when the men to do the interfering are actuated with the best motives, can be demonstrated. The effect of the regulations to control issues of capital was lopsided. For instance, permission was given to one company to double its capital. The only reason to suggest itself for such action must be that its shares stood high in the market, and then refusal was given to another company to register a new company as a part of an option bargain with the mine vendors—although the new company was to test a large low-grade gold deposit. The effect of the interference by Treasury officials was to drive the prospector from the back country. If he could not interest the promoter, where was he to get the cash with which to go

on or to reward him for pioneering in one of the most barren and god-forsaken regions in the world? The whole arrangement was stupid, so stupid that one can only connect it with the regulation that prevented the free sale of zinc concentrate to Japan, which at the time was assisting in patrolling the Pacific and ensuring the safety of Australia.

So it can be affirmed that the gold-mining industry of Australia is today worse off than ever before. It suffered first of all from the withdrawal of men from work in order that they might serve their country at the front. Then it was affected by the high price of supplies, these in some instances rising to 200 or 300% above the pre-war rate. Moreover, the fact that a standard price ruled for gold in the Empire and that the Government for long forbade exportation, in order that it might add to the backing of the ever-increasing note-issues, meant that the buying price of the pound sterling dwindled astonishingly and as the Arbitration Court put up wages it was no wonder that mines began to be shut-down. Worst of all, through the blotting out of the promoter, no prospectors were in the open to continue the search for mines. One official controller, when questioned regarding this phase of his activities, seemed to fear that there would be some financial cataclysm if the modest little promoting syndicates so common in Australia with a capital of a few thousand pounds were permitted to be formed, whereas the waste and expenditure in a dozen other directions, where control ought to have been exercised, was almost without limit. Even now, when the Prime Minister is preaching that the only thing that can save the nation is production, and when everyone would welcome the discovery of a new goldfield, the restrictions remain. It is always too difficult to shift a governmental department once it has been established. That applies to the office established to control the issue of capital in Australia during the War.

However, it is interesting to note that a party of men who have been working on Hampton Plains, some 25 miles south of Kalgoorlie, have been responsible for a boom in gold mining. This is due in part to the nearness of the find to the Golden Mile of Kalgoorlie, and in part to the popular belief that the discovery is a continuation of that famous series of gold mines. What helped to bring the claim into prominence was the fact that Richard Hamilton, Mr. McDermott, and two or three other of the biggest mining men in Kalgoorlie took an option over the property at a high figure. Since that was done they have carried out a vigorous development policy and high-grade ore has been opened up by them down to a depth of 100 ft., at which point driving north and south along the line of the ore-shoot is going on. The lode is 25 ft. wide and assays several ounces per ton, but it has yet to be proved that the richness persists into the sulphide zone. That has been the crucial point with all other mining 'shows' in the district. Hundreds of new claims have been pegged out on the line of the lode, or east and west of it, and 'shows' that under other circumstances would not attract attention have

been taken under option for £10,000 or £20,000 each. Apart from the fact that the discovery in the main shows richness, so far none of the other claims among the host pegged out has given what can be even regarded as a satisfactory account of itself.

The old goldfields of Australia are slowly dying. Charters Towers and Gympie, in Queensland, are 'has beens', and it is copper rather than gold that brings grist to the shareholders of the Mt. Morgan mine. In New South Wales, the gold-dredging industry is done and the yield of the precious metal is almost negligible. Victoria has suffered greatly; deep-lead mining is at a standstill; although there are deep gutters awaiting exploration, the results from the mines that have struggled along are so disappointing and the calls for capital are so incessant that there is still little inducement to continue or to engage in fresh ventures. So far as quartz mining goes, the story is the same; an ambitious attempt was made not long ago to revive Bendigo by merging a number of the claims in the central area; it was hoped that costs would be cheapened and the output so enlarged that profits would come with better organization, but results to date have been disappointing. Bendigo bears testimony to Mr. Rickard's opinion that with depth gold values fade. It might have been better if the promoters of the merging project had devoted more of their attention to the side-lines of the 'saddle reefs', but in all probability enterprise in that direction was checked by the disappointing results obtained from operations on the main lines where the yield had been expected to be good. Nowhere in Victoria have finds been made to fill the gap occasioned by the closing of exhausted properties. The same thing has been going on in Western Australia. Mining at Kalgoorlie is on the decline; the Westonia field, which was at its zenith when the War broke out, appears to be petering out. Perhaps Hampton Plains may bring a few new mines into existence, but, so far, only one claim has made a good showing. Still, it is interesting to note that the result of the boom in that locality has led to the fitting out of scores of prospecting parties, thereby indicating how an active market will stimulate mining activity.

What has been said about gold mining applies to base-metal mining. Prospecting has been almost a dead letter save for the secondary minerals, such as molybdenite, wolfram, and antimony. The high price ruling for the first two, and later on for arsenic, attracted men into the field and there has been a notable increase in output, especially of molybdenite. In this connection the progress made by applying the flotation process to the recovery of this mineral is noteworthy. But mine operators are anxious; they do not know whether prices are likely to collapse now that the War is over.

Tin mining is another fading industry; despite that fact it is said that capital is forthcoming for starting a tin-plate industry in Australia. That this is possible is because of the magnificent steel and iron works the Broken Hill Proprietary Co. has established at Newcastle to treat the ore from the Iron Mount in South

Australia. This enterprise is by far the most important industrial project launched in Australia for many years. The works are extensive and embody the very latest improvements in manufacture. The high prices ruling for iron and steel during the War enabled the company to earn large profits, and, with the wisdom that has characterized the control of its affairs, the directors used a large proportion of their surplus to expand this enterprise. Now a strong agitation is maturing to give the company, and the nest of enterprises being built round its central works, the benefit of strong protective duties, although it is not so long since it was said that the richness of the ore, the excellence of the appliances and their splendid arrangement, as well as the close proximity of the works to cheap coal meant that no tariff aid was necessary. The dread of dumping by the United States and by China and Japan is the reason given for the request, which is sure to be considered favorably. It may be added that the success of the enterprise has led the Queensland labor government to venture in the same direction. Large deposits of iron and coal exist in that favored State and so the Government, if it continues to live, will be enabled to carry out one of the cherished ideals of the Labor party there—the nationalization of the iron and steel industry.

With no fresh discoveries to add to the resources of the Commonwealth, the output of lead, silver, and zinc has been restricted mainly to Broken Hill, because the few mines of this kind at work in Tasmania, Queensland, and Western Australia were so small that they were not serious factors. This output, as stated, has been under the control of the Metal Exchange. Mining at Broken Hill has gone on fairly steadily, the mines making splendid profits, thanks to war prices. Outputs were less than before, partly because of troubles with labor in various directions. The field is slowly being exhausted; at mines like the Broken Hill Proprietary, Block 14, Block 10, British Junction, and Junction North, one can fairly well see the end of the reserves. The present big mines are the South, the North, and the Zinc Corporation's South Blocks mine. These claims are at opposite ends of the line of lode and get ore on the pitch from the mines either to the south or the north of them. They are all huge concerns with many years of life ahead of them. In point of fact, they really are the backbone of the proposed Electrolytic Zinc Co., which is starting the manufacture of zinc electrolytically in Tasmania, where cheap water-power is available. The industry is being backed by the British government, which has promised to take a large proportion of the zinc products of Broken Hill for ten years after the War at "a satisfactory price". The same people are connected with the Port Pirie lead smelter, into which they bought from the Broken Hill Proprietary on terms that gave them a dominating interest. It is said that they have altered the establishment almost out of recognition, with the result that a great saving in treatment is assured. Important metallurgical experimenting has been done in regard to the better treatment of lead-zinc ores, and it is rumored that

a method has been devised that almost constitutes a technical revolution.●

Copper mining has had many vicissitudes, but it appears to be overcoming them. Mount Lyell, Mount Morgan, and the north Queensland group still represent the giants of the industry. The end of Mount Morgan apparently can be foreseen, although it has years of life ahead. Mount Lyell goes on smoothly under Robert Sticht's management, with shoots of ore still opening up in the North Lyell and the Comstock claims alongside. The same company is proceeding with its development at Mount Reid and Rosebery, where it owns a group of claims having large resources in high-grade zinc and lead ores. The financing of the mines has been done so far by the Mount Lyell company, but it contemplates an expenditure of £750,000 on electrolytic works, so that an appeal will have to be made outside, possibly a debenture issue. In Queensland the labor element has been most aggressive and it is clear that mines there cannot pay under present-day conditions with copper at £80 per ton. The best news from there has been the opening up of the Mount Oxide mine, where some 250,000 tons of 10% copper ore is proved. This mine, however, wants a railway to bring it into touch with the world.

The point of all this review is that the mining industry in Australia is depressed owing to the operation of three factors—high cost of labor and supplies, Government interference, and above all the lack of developments in any old or new centre. It is fitting to say a word or two, before ending, about the development of the brown coal industry of Victoria, in which, with two or three others, I have had much to do in stimulating the Government of Victoria to action. These deposits are larger than those of Saxony and are quite as accessible to the miner. In quality they are equal, if not better, in grade. The drawback to their development by private enterprise has been the determination of the State Legislature that the State must control the supply of electricity. Strikes in Newcastle cut Victoria from its supplies of fuel, and with war, labor, and repatriation problems looming in the distance, a small body of enthusiasts set to work to educate public opinion as to the value of this resource to the State. The matter has now been advanced so far that the State is practically committed to the carrying out of the project of developing the coal for power purposes at a cost of fully £1,500,000. The question of the utilization of the coal for by-products will come up later.

THE asbestos-bearing belt of eastern United States extends from Quebec, Canada, to the State of Alabama, a distance of about 1600 miles. The northern part of the belt in Quebec contains the world-famous deposits of chrysotile asbestos, and these deposits extend southward into Vermont. From Vermont southward, practically all the asbestos found is of the amphibole non-spinning type. Such fibre has been worked in Massachusetts, Connecticut, Maryland, Virginia, and Georgia. The occurrence near Great Falls is remarkable in the fact that it is chrysotile instead of amphibole asbestos.

The Two Professions of Mining Geology

By AUGUSTUS LOCKE

In offering this paper I have two principal purposes in view: (1) to indicate a confusion existing in the public mind through the use of the term 'mining geologist' by two distinct professions; and (2) to discuss certain disadvantages caused by this confusion.

The accomplishment of these purposes will necessitate plain speaking; it will involve an ingredient of caricature and ridicule. But if there are statements which seem discourteous to honorable names, I disclaim any intention of making them so. The bearers of those names are justly famous in a certain branch of mining geology, so-called. If there is another branch, into which they sometimes venture and in which some of them are not worthily proficient, then there can be no objection to an examination of the facts: indeed the very men involved will be among the first to admit the facts, once they are established.

The two professions (or two branches of mining geology) to which reference is made are those concerned respectively with mining litigation and with the search for ore. For convenience the work of the first may be termed 'court' geology and the work of the second, 'ore-hunting' geology.

The belief that these are, in fact, two distinct professions is supported by several arguments. The ore-hunting geologist, ideally, possesses a judicial temperament. He has the power of poised and suspended judgment—of seeing each object from various viewpoints; he has a mental suavity; he can understand and welcome thoughts born of other minds. He has both imagination and patience; he is vigorous without being controversial. He has an active ingenuity in the search for truth; he will travel far to complete a concept, or to gain impressions from a distant ore deposit and apply them to the study of one that is nearer home. He possesses not only honesty of purpose, but ability to distinguish the source of an idea; he will see his own motives, and will know unerringly when some ill condition of the body has cast a shadow on his mind. He will have his principal professional interest in geological reasoning and its application to mining. He will prefer the discovery of an orebody to the acquirement of a fortune in money.

As a matter of fact he cannot have all these characteristics, but he must aspire to them, lest he be stampeded into one-sided conceptions. The complications of his subject, and the youth and incompleteness of its technique make a thorough-going judgment exceedingly difficult. Prejudice is the ore-hunter's devil, and prejudice tends eternally to fill in where knowledge is deficient. The man of dignified and grave demeanor is urged from without and within to use his convincing personality,

which is always available, in place of that logic which, despite laborious efforts, must often say, "I do not know". Judicially written geological reports will usually contain confessions of ignorance. Rare indeed are such reports and common are those that, in a logical analysis, fail to carry conviction—that, in effect, rest on some obscure prejudice.

The court geologist, on the other hand, needs the mind of an advocate. He must be "dextrous and able in explaining the grounds of his opinion".¹ He is suitable for court work in proportion as he has the ability, though taking sides and maintaining a partisanship, to convince the Court. It is not a scientifically sound structure that he must aspire to, but one that looks good to the Court. His reasoning may be defective; for the Court will apply no very stringent tests: in geology, the Court is no more than an amateur critic. It is not so much logic as personality that will speed the argument. If the witness bears a look of wisdom and deliberation, if he has a convincing address, he will go far toward victory.

During a trial in court, prejudice jumps to the front. The trial is a game. The witnesses are sportsmen; they act with a superb team spirit; they will do or die. Success promises a delight that awakens a predominant motive. The formal-looking models and maps, the long night conferences, the hurried consultations, the interminable rehearsals of evidence—these are controlled by that motive: they banish calm thought. Who can be both advocate and judge?

Let us consider the Elm Orlu v. Butte & Superior lawsuit of 1915. On either side were five principal geological witnesses. A shrewd spectator said, "Here are five of the most eminent geologists in the United States employed by the Elm Orlu company, and five others equally eminent employed by the Butte & Superior company. This five, to the man, are all of one opinion; that five, to the man, are all of the opposite opinion."

This situation unquestionably signified not dishonesty, but merely prejudice. It signified mere prejudice, too, even when there developed plain contradictions regarding easily ascertainable facts, and when there appeared two sets of maps showing in the same workings differences that the ore-hunting geologists could not but see with astonishment. One could predict the burden of an answer, the general effect of a piece of evidence. "Are the Jersey Blue vein and the Rainbow lode contemporaneous?" Mr. Winchell's chorus says, "No!" Mr. Finch's chorus says, "Yes!" But why the chorus? Because a single affirmation of an opinion is far less con-

¹Hazlitt, 'Table Talk', Essay IV.

vincing than its five times reiteration, gravely performed by men of sober mien.

How, it will be asked, is such a result compatible with honesty? I consider it entirely so. To a given witness, sustaining a particular contention, the prejudice seemed to lie wholly with his opponents: he asked himself conscientiously again and again how these able men could have achieved such an inconceivable bigotry. And yet, among the complicated elements of an argument, where, in case after case, the weight of a straw would be decisive, he was himself putting the straws all on one side; instead of letting them lie where they fell, as the scientist must do, he unconsciously shifted them a little, and then, proudly and confidently, showed the emphatic result.

In reality, prejudice of this sort, wholly honest, yet from the logical standpoint unfair, is a natural condition even among technically trained men. William James has numerous discussions touching upon it: he vividly describes 'apperception', that process by which a given object makes wholly different effects on different minds because in entering those minds, the impression is engulfed in a variety of mental environments.² "It is the fate", he says, "of every impression thus to fall into a mind preoccupied with memories, ideas, and interests. The self-same person, according to the line of thought he may be in, or to his emotional mood, will apperceive the same impression quite differently on different occasions. A medical or engineering expert, retained on one side of a case, will not apperceive the facts in the same way as if the other side had retained him."

It is not, then, a matter of honesty that separates the court geologist from the ore-hunting geologist, but a matter of temperament and circumstance. I am writing with no intention of condemning the motives of the court geologist, for his motives are both natural and useful. One who condemned them would be little more than a cynic—he would condemn lawyers, for example, and salesmen, and men who, for an idea, risk their lives in battle. Court geology is often not geology at all, but a matter of legal word-definitions; or, geologically considered, it depends less on logic than on feeling: it is unscientific—that is the burden of my argument.

For court work and for ore-hunting, the faculties needed, then, are sharply different. In so far as a man is, by nature and training, suited to the one profession, he is, in large measure, unsuited to the other. If he be the calm and patient investigator, willing to postpone his conclusions till the time of their maturity, he is little fit for the court-room. If he be the ready and resolute fighter, fond of the contest for itself, a wit-snapper, shrewd in avoiding traps and skillful in returning the wily answer, he is not the best man for the profession of ore-hunting. Perhaps in these days, when the profession of ore-hunting is young, the court-geologist may sometimes perform in it relatively well; but it is by nature a profession foreign to his abilities, and a little while hence he will have no place in it.

Perhaps, again, there is now and then one who can actually handle both professions well; who, being of judicial mind,³ so carefully studies a case in advance that he is certain of his ground before he enters upon it; who is able, therefore, to support his contention calmly. But such a man must have uncommon wisdom and virtue. It is no easy task to choose the right side of an apex question. In the Butte case referred to, a choice would necessitate very extended work. A witness may desire to choose correctly, but no mining company will permit him months of indecision when it can secure men who will choose in a day or a week. Those incapable of speedy and favorable decision on point after point, despite complexities, are condemned as poor witnesses. Or, they are shrewdly confined by their more experienced teammates to selected portions of the case where their testimony will be unequivocal. Or, at last they are caught up in the enthusiasm of the game: even the patient scientist will strongly tend to yield and become biased in his thinking when hustled about by the exigencies of a court trial.

When it is realized that ore-hunting geology needs a minimum of prejudice and that court-geology needs, if not a maximum, at least a substantial ingredient, it will be understood that the two cannot mingle advantageously. But in the past they have mingled inextricably. Many of the more famous mining geologists doing commercial work have been chiefly court geologists. To them the owners of mining companies have turned, regardless of the kind of geological study needed. And they have done this naturally enough, making no fine distinctions between two geological professions and preferring the well-known man to the obscure. And they have done it for another reason: ore-hunting geology, though in essence a distinct profession, has scarcely yet established itself as such. Its personnel is small; its technique is somewhat crude; its outlines are hazy; its possibilities of achievement are little-known. The fact that much of its work has been performed by men saturated with court work has helped to keep it in this condition. And the very existence of this condition has caused court geologists to do its work. The effect has been to carry the prejudices of the advocate into ore-hunting geology. It has delayed and is today delaying the development of geology as a useful instrument in mining. While at the first ore-hunting geology grew in a measure out of court geology, now the parent is a sore impediment to the child.

The time is approaching when ore-hunting geology can assert itself as a distinct profession. That time will come the quicker if those geologists who have the judicial temperament and who are employed in ore-hunting will avoid court work, in the sense here discussed, altogether. It will come the quicker, too, if the judge in some conspicuous apex case of the future will demand the employment of geologists not to stand beside the respective litigants but to advise the Court. That case would be one in which the judicially minded geologist could, with all propriety and cheerfulness, engage.

²'Talks to Teachers', p. 157.

Statistical Review

Production of Metal Mines for 1919*

Colorado

The mine output of gold, silver, copper, lead, and zinc in Colorado for 11 months of 1919 and the estimated output for December, according to data compiled by Charles W. Henderson, amounted to \$9,892,000 in gold, 5,630,000 oz. of silver, 35,650,000 lb. of lead, 3,400,000 lb. of copper, and 52,300,000 lb. of zinc, having a total value of \$22,522,000 as compared with a production in 1918 of \$12,751,718 in gold, 7,063,554 oz. of silver, 65,960,760 lb. of lead, 6,277,332 lb. of copper, and 89,133,901 lb. of zinc, having a total value of \$34,160,172. This estimate shows a decrease of \$2,860,000 in gold, 1,430,000 oz. of silver, 32,160,000 lb. of lead, 2,877,000 lb. of copper, and 36,834,000 lb. of zinc. Even at the increased value for silver of \$1.11 (average) as compared with \$1 in 1918, the value of the silver produced in 1919 was \$6,249,000 as compared with \$7,063,554 in 1918, and with the lower average prices for lead, copper, and zinc there were respectively decreases of \$2,651,000, \$915,000, and \$4,398,000.

Naturally the lead-copper plants in the State were not operated at full capacity. The Globe plant ceased to receive ores in April 1919, but the Leadville, Pueblo, Durango, and Salida plants were worked at reduced capacity. The United States Zinc Co.'s zinc-retort plant at Pueblo was operated at greatly reduced capacity. The River Smelting & Refining Co.'s plant at Florence continued to treat low-grade zinc-lead-copper ores from Colorado only. The Western Zinc Concentrating Co.'s plant at Leadville was operated at increased capacity on Leadville zinc-carbonate ores, and the Ohio Zinc Co.'s zinc-oxide plant at Cañon City was also operated at increased capacity on zinc-carbonate ores from Colorado, Nevada, and Utah. The Empire Zinc Co.'s magnetic-separation mill at Cañon City was operated steadily on Leadville zinc-sulphide ores, but the Western Chemical Co.'s magnetic-separation wet-concentration mill, treating similar ores, was operated for only a part of the year, although the Western Chemical Co.'s sulphuric-acid plant was active on pyritic ores and also made considerable electrolytic zinc. Copper ore and matte and cyanide precipitate were shipped from Colorado to the smelter at Omaha and some copper ores were shipped to plants in Utah. The quantity of zinc ores shipped to zinc smelters and zinc plants in Kansas, Oklahoma, and Eastern States decreased heavily. Shipments of manganese, which had assumed considerable magnitude in 1918, ceased with the expiration of contracts on July 1, 1919.

Cripple Creek produced \$5,830,000 in 1919 as compared with \$8,119,747 in 1918, a decrease of \$2,280,000.

The Golden Cycle roast-cyanidation mill at Colorado Springs, which treats about 95% of the high-grade ore shipped from Cripple Creek, was operated steadily except for a three weeks shut-down during the coal strike in November, when it gave its coal to the city of Colorado Springs. In October the Vindicator washing and flotation mill at Victor was closed, so that less ore was available for the Golden Cycle mill. The Portland Independence cyanidation-concentration mill at Victor was the only mill actively operated throughout the year in the Cripple Creek district.

Lake county, chiefly Leadville, but including also Lackawanna Gulch, Sugar Loaf, and St. Kevin lode districts and the Arkansas River dredge district, produced \$624,000 in gold, 1,515,000 oz. of silver, 10,500,000 lb. of lead, 800,000 lb. of copper, and 37,000,000 lb. of zinc, having a total value of \$5,700,000 as compared with a production in 1918 of \$843,239 in gold, 2,290,121 oz. of silver, 1,626,534 lb. of copper, 22,469,915 lb. of lead, and 46,715,736 lb. of zinc, having a total value of \$9,381,610. Early in 1919 the low price of zinc and lead caused the Leadville operators to post a reduction of \$1 per day in wages which the miners met by a walkout; the result was a cut of 50 cents per day in wages and the closing of several large properties. The long productive Western Mining Co.'s properties were closed at the end of 1918. The Town Town Mines Co. continued operations throughout 1919.

Despite the removal of the pumps from the lower levels at Aspen early in the year, there was a production of 647,000 oz. of silver and 5,000,000 lb. of lead, making an increase for silver but a heavy decrease for lead from that district.

In the San Juan region, the Telluride district was the only one to maintain its production at normal, the output being \$2,100,000 of gold and 1,380,000 oz. of silver, but the contemplated closing of the Liberty Bell mine and mill, which has been in continuous successful operation since 1896, foreshadows a decrease in production in that camp for 1920. The Tomboy Co. at Telluride built a new mill and the Smuggler Union Co. added to its plants during 1919, but the increase in the output of these companies must be considerable to equalize the loss of the Liberty Bell. At Silverton the production has been less than it has been for several years. The fire which burned the Sunnyside office buildings and the miner's boarding and hotel buildings early in 1919 prevented that large producer from starting complete operation. The Iowa Tiger mill continued operations and made large production. At Ouray, the Camp Bird Co. did much exploring work on the vein at the end of its new low-level adit but did not start milling. The Atlas

*From preliminary reports of the U. S. Geological Survey.

and Mountain Top mines were in operation, and much development and some shipments were made at Red Mountain. Mines in La Plata county made very little production, although development work was done during the summer. Dolores county continued to ship copper ore from Rico, but no lead-zinc ore. Mineral county which had produced, at Creede, a greatly increased quantity of silver in 1918, showed a considerable decrease in 1919, as one of the largest lessees abandoned work there and one of the other large properties was not so productive as it was in 1918. The production in Hinsdale county again dropped to only desultory shipments of miscellaneous ore.

Early in 1919 the Wellington Co., at Breckenridge, found itself without a market for its zinc concentrate but continued operation for a few months, storing its concentrate. In September this company began shipping its stored concentrate and shipped also some iron-sulphide ores. The production of zinc from Summit county, therefore, which was 15,696,264 lb. in 1918, was only about one-third as much in 1919. Dredges in Summit county produced \$450,000 in gold in 1919 as compared with \$431,000 in 1918.

The mines at Red Cliff, Eagle county, were active only during the early part of the year, but development only was carried on at the zinc mines during the last half of the year.

Production in Gunnison county was confined almost entirely to the zinc produced by the Doctor mine, on Spring creek, from which there were increased shipments of zinc-carbonate ore, and to small shipments of gold-silver ore from Iola and from Ohio City.

Boulder county increased its output of silver from 157,000 oz. in 1918 to 203,000 oz. in 1919 from the Yellow Pine at Sugar Loaf, the White Raven at Ward, and from the mines at Caribou. The mines in Gilpin county were not active, and the closing of the Argo mill, and its associated Tremont (Gunnell) mine at the end of the Argo adit, reduced the production greatly. This county produced \$83,000 in gold and 72,000 oz. of silver. The Becky Sharp mine produced considerable gold ore, and the Gilpin Eureka shipped amalgam bullion and concentrate.

In Clear Creek county the low price of lead and zinc closed the principal producing mines at Silver Plume in May, 1919, and thus cut off the usual large silver contribution from that camp. There was a production from this county, however, of \$226,000 in gold and 334,000 oz. of silver. Early in the spring the new Colorado Central mill, near Georgetown, increased its capacity and throughout the year contributed considerable silver in concentrate derived from the treatment of material from the Equator dump. The mills at Idaho Springs were not active in 1919, for the Argo and Jackson were closed, and the Hudson and Newton were operated only on part capacity. The Little Mattie mill resumed operations at the close of the year.

Park county made appreciable increases in the output of gold and silver.

Idaho

The value of the gold, silver, copper, lead, and zinc mined in Idaho in 1919, according to the estimate of C. N. Gerry, was about \$19,376,000, a decrease of \$17,146,000 from the value in 1918. The decrease in the quantity of all the metals produced but gold, as well as in the total value of the output, was decidedly great, and was due in part to the difficulty in marketing copper, lead, and zinc, to the lower prices for these metals, and to the high cost of labor and supplies. In August a labor strike in the Coeur d'Alene region prevented shipments from many of the large mines near Wallace. Fortunately labor troubles failed to close the mines near Kellogg, and the Bunker Hill smelter and refinery at Bradley were active throughout the year, though not running at full capacity.

GOLD. The mine output of gold in Idaho was valued at \$703,000 in 1919, a value close to that of 1918. The largest output of gold was made by the Gold Hill & Iowa property, in Boise county, though the dredge at Murray, in Shoshone county, produced considerable gold. In Boise county no dredges were operated, and in Lemhi county there was only a small dredge output.

SILVER. The mine output of silver decreased from 9,172,340 oz. in 1918 to 5,701,000 oz. in 1919, nearly 38%, an unusual decline, and the value decreased from \$9,172,340 to \$6,340,000. Decreases amounting to 300,000 oz. or more were reported by the Hercules, Morning, Hecla, and Tamarack & Custer mines. Smaller decreases were reported by the Bunker Hill, Caledonia, and Gold Hunter. The largest silver producer of the State was the Bunker Hill & Sullivan mine, at Kellogg, which was followed by the Hecla mine, at Burke. Other large producers of silver were the Morning, Caledonia, Gold Hunter, Hercules and Tamarack & Custer mines. The mines in the Coeur d'Alene district produced about 4,800,000 oz. of silver, or about 84% of the total of the State.

COPPER. The mine output of copper decreased from 6,533,888 lb. in 1918 to 3,100,000 lb. in 1919. The value of the output decreased from \$1,613,870 to \$591,000. The Empire Copper Co., at Mackay, was the largest producer of copper, but the output was only about 40% of that in 1918. The National Copper mine, near Mullan, produced considerable copper concentrate, but was closed late in the year. The shipments from the Richmond mine, near Adair, were considerably reduced. Smaller shipments came from Lemhi and Custer counties.

LEAD. The mine output of lead, which is the most abundant metal in Idaho, decreased from 294,695,993 lb. in 1918 to 184,000,000 lb. in 1919. The average price was somewhat lower, and the value of the output decreased from \$20,923,416 to about \$10,529,000. The Bunker Hill & Sullivan mine made the largest output of lead; the Hecla, Morning, and Hercules were the next largest producers. Considerable lead was also produced by the Tamarack & Custer, Gold Hunter, Consolidated Interstate Callahan, Caledonia, and Sierra Nevada

mines. The Coeur d'Alene district produced about 172,000,000 lb. of the total output of lead. In other districts of the State large quantities of lead ore and concentrate were shipped from the Idaho Continental, Pittsburgh-Idaho, Latest Out, and Independence mine, near Ketchum, in Blaine county. Large shipments were also made from the old Minnie Moore mine, situated near Bellevue.

Zinc. The mine output of recoverable zinc in Idaho decreased from 45,161,712 lb. in 1918 to 16,565,000 lb. in 1919. This decrease of over 28,596,000 lb. was largely due to high costs and to the lower price of spelter. The largest decrease was reported by the Consolidated Interstate Callahan, which was active only about four months of the year. Large shipments of zinc concentrate, nearly equal to those of 1918, were made by the Morning mine, and shipments were made also by the Success and Frisco mines. No zinc ore was shipped from Blaine county.

The dividends paid by Idaho mining companies for eleven months of 1919 amounted to \$2,000,000.

Oregon

A preliminary estimate of the production of metals in Oregon in 1919, compiled by Charles G. Yale, shows a decrease in the gold and lead produced but an increase in the silver and copper. According to the mines report the output of gold in 1918 was \$1,270,465 and the estimated output in 1919 is \$1,072,661, a decrease of about \$197,804. The output of silver in 1918 was 107,323 oz., valued at \$107,323; in 1919 it was 211,523 oz., valued at \$234,790. The output of copper in 1918 was 2,451,016 lb., valued at \$605,401; in 1919 it was 2,638,714 lb., valued at \$501,355, an increase in quantity of 187,698 lb. and a decrease in value of \$104,046. The output of lead in 1918 was 10,601 lb., valued at \$753; the output in 1919 was 2000 lb., valued at \$114, a decrease in quantity of 8601 lb. and in value of \$639.

The decrease in the gold output of the State was due to some extent to the scarcity of skilled labor, to the increase in its cost, and to war conditions generally; but the main cause was scarcity of water and power for hydraulic, dredge, and deep mines. The water in the streams of the State was so low during the last two months of the year that hydro-electric power was entirely cut off from large properties, including the dredges, and was furnished for domestic use only. The larger dredges were shut-down in November and December for lack of power, so that the dredges of the State, which ordinarily produce 57% of the placer gold and 22% of the total gold, produced, combined, only \$301,900, or \$85,840 less than in 1918, a decrease of 22%. The larger deep mines were similarly affected. Direct returns from all the dredging companies and the larger deep mines of the State show a general falling off in the output of gold for the year.

Returns from inquiries to postmasters, merchants, dust-buyers, and others reveal the fact that many mines in Oregon were idle during 1919. Higher wages in other industries attracted miners away from their regular op-

erations, and costs were so high that the smaller mining operations were unprofitable.

Most of the Oregon placers are worked by the hydraulic system, but the gold output of the dredges is greater than that of all other forms of placer-mining combined.

There are only about a hundred producing metal mines in Oregon and six of these produce 80% of the total output of all the metals mined in the State, and one of them produces 25% of the total value of the metals produced. These six mines are those of the Baker Mines Co., Cornucopia Mines Co., Homestead-Iron Dyke Co., and the Commercial Mining Co., all in Baker county, and the Queen of Bronze Mining Co., in Josephine county. The only placer-mine in this group is the Powder River Gold Dredging Co.

The larger copper companies of the State, which are in Baker and Josephine counties, show some increase in output during the year, notwithstanding unfavorable conditions. The most productive county in the State in all metals is Baker, which produces nearly 80% of the gold and of the total value of all metals mined. Though less ore has been produced in Oregon during the last two years than in 1917, the average value of all the metals mined and treated has increased about 90c. per ton. The relative rank of the counties of Oregon in the production of gold is as follows: Baker, Grant, Josephine, Jackson, Crook, Douglas, Umatilla, Clackamas, Lane, Malheur, Wallowa, Curry, and Wheeler.

South Dakota

Preliminary estimates, made by Charles W. Henderson, indicate that gold mines in South Dakota produced \$5,391,000 in 1919 as compared with \$6,565,337 in 1918 and 114,000 oz. of silver as compared with 159,202 oz. in 1918. The ores shipped to smelters contained only nominal quantities of lead and copper.

At the end of 1918 the Homestake mines and mills were operated at only 77% capacity. Shortage of labor continued during the year 1919, but production began to increase in April. Production continued steadily until September 25, when a fire was discovered on the 800-ft. level. Later this fire reached the 700-ft. level, and it was found necessary to flood the mine to the 600-ft. level.

While the mine was flooded—during October and November—the operations at the mines and mill were necessarily curtailed, but they were resumed December 1. The Mogul mill was closed during the later part of the year, and the Trojan mill was the only one that was operated without interruption. These three companies were the only large operators in 1919.

Texas

According to Charles W. Henderson, the Presidio mine, at Shafter, was in continuous operation during the year 1919. Small shipments of copper, lead, and zinc ores were made from the Van Horn and Sierra Blanca districts. The production for the State for the year was

540,000 oz. of silver and nominal quantities of gold, lead, copper, and zinc.

Utah

The output of gold, silver, copper, lead, and zinc from mines in Utah in 1919, according to Victor C. Heikes, had a value of about \$45,439,000, which represents a decrease of nearly \$41,000,000 from the value of the output in 1918. There were decided decreases in both the quantity and value of the metals produced. The average price of silver for the year was much higher than in 1918, but the prices of copper, lead, and zinc were much less. The mining industry was seriously affected by high costs of operation, lower prices of the metals, and a labor strike at Park City, which closed the mines of that region for two months.

Despite these difficulties the four smelting plants of the State were active throughout the year, but they were not operated at full capacity.

GOLD. The mine production of gold decreased from \$2,949,170 in 1918 to approximately \$2,070,000 in 1919, a decrease of nearly 30%. Most of the gold came from copper, lead, and zinc ores that were treated at smelting plants. No great amount of ore was either amalgamated or cyanided, though some ore was amalgamated at the Wedge mine and some was cyanided at the Deer Trail property, both in Piute county. More than half of the output of gold in the State came from the Bingham district, about one-fourth from the Tintic district, and the remainder from the Park City region and other camps. The largest producers of gold were the United States Mining Co., Utah Copper Co., and Utah Consolidated Mining Co., of Bingham.

SILVER. The mine output of silver decreased from 13,455,597 oz., valued at \$13,455,597, in 1918, to 11,569,000 oz., valued at \$12,865,000, in 1919. The Chief Consolidated mine at Eureka was again the largest producer of silver in the State, and the Tintic Standard followed closely. The output of the Tintic district was maintained, but decreases occurred at Bingham and Park City. In the Bingham district the United States Mining Co., Utah Consolidated, Utah Copper, and Utah Apex were the largest producers of silver, and at Park City the Silver King Coalition and the Ontario mine were large producers.

COPPER. The mine production of copper decreased from 227,169,630 lb. in 1918 to 123,626,000 lb. in 1919. As the average price was considerably less, the value of the output decreased from \$56,110,899 to \$23,242,000. The largest production of copper came from the Utah Copper property at Bingham, which yielded close to 9,000,000 lb. per month throughout the year, a decided decrease. Next to the Utah Copper, the Utah Consolidated was the largest producer of copper, followed by the Ohio Copper Co. and the United States Mining Co. In the other districts the principal producers of copper were the Ophir Hill, at Ophir, the Mammoth mine, the Centennial Eureka, and the Tintic Standard, in the Tintic region, and the Bingham Mines Co. at Bingham.

LEAD. The mine output of lead decreased from 167,008,224 lb. in 1918 to 121,249,000 lb. in 1919, a decrease of nearly 46,000,000 lb. The value of the output decreased from \$11,857,584 to \$6,935,000. The largest producers of lead in the State were the United States Mining Co., Utah Apex, Utah Consolidated, Ophir Hill, Silver King Coalition, Tintic Standard, and Chief Consolidated mines.

ZINC. There was a decrease of about 77% in the production of recoverable zinc. The mine output decreased from 18,399,417 lb. in 1918 to 4,467,000 lb. in 1919, and the value of the output from \$1,674,347 to \$326,984. The principal producers of zinc were the United States Mining Co. and the Utah Apex Mining Co., at Bingham; the Judge Mining & Smelting Co., at Park City; and the Scranton mine, Tooele county. The electrolytic plant of the Judge Mining & Smelting Co., at Park City, was active for only six months of the year. Much of the decrease was due to the idleness of the tailing plants at Frisco and Midvale.

In 1919 the mines of Utah produced approximately 6,427,000 tons of ore, a decrease from 14,705,718 tons in 1918. Of this total, the Bingham district produced 5,913,000 tons, as compared with 13,607,650 tons in 1917. The production of the district is estimated as 56,000 oz. of gold, 1,600,000 oz. of silver, 117,000,000 lb. of copper, 54,000,000 lb. of lead, and 2,674,000 lb. of recoverable zinc. There was a decrease in the Tintic district, where the mines produced 265,000 tons of ore, exclusive of iron ore, as compared with 362,494 tons in 1918. The estimated production of the district was 25,000 oz. of gold, 6,800,000 oz. of silver, 2,800,000 lb. of copper, 24,000,000 lb. of lead, and a small amount of zinc. The mines that had an output of more than 1000 tons during the year were the Dragon, Chief Consolidated, Iron Blossom, Eagle & Blue Bell, Tintic Standard, Centennial-Eureka, Grand Central, Swansea, Mammoth, Colorado, Ridge & Valley, Empire, Bullion Beck, Gemini, and Victoria. The Tintic Milling Co. treated much ore locally and shipped bullion that contained gold, silver, and copper. Shipments of ore and concentrate from the Park City region in 1919 amounted to 63,325 tons, a decrease from 89,588 tons in 1918. Tabulation of the mines that made the largest production gave an estimated output for the district of \$64,083 in gold, 1,800,000 oz. of silver, 625,000 lb. of copper, 20,000,000 lb. of lead, and 1,350,000 lb. of recoverable zinc. The decrease was general, on account of the idleness of the mines during the two months of the strike. The mines of Ophir and Rush Valley districts produced 73,000 tons in 1919, as compared with 81,475 tons in 1917. The main producers were the Ophir Hill Consolidated and Bullion Coalition mines. About 18,250 tons of ore was shipped from the Big Cottonwood, Little Cottonwood, and American Fork districts, as compared with a total of 35,269 tons in 1918. In Beaver county shipments decreased from 43,426 tons in 1918 to about 9400 tons in 1919. A large production of bullion and concentrate came from the Deer Trail mine, in the Ohio district, of Piute county.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

HOLBROOK MINE TEMPORARILY SHUT-DOWN BY COPPER QUEEN COMPANY.

DOUGLAS.—A system of sanitation, begun late in 1919 by the Phelps Dodge Corporation at its Copper Queen smelter here, now is well on the road to completion. Sewer lines, costing about \$10,000, have been finished. Approximately \$20,000 more is being spent by the company on septic tanks, change-rooms, comfort stations, and other improvements. When completed the Copper Queen will be one of the most comfortable smelters in the country from the standpoint of employees. The changes were made in compliance with the Arizona law. The following officials of the Phelps Dodge Corporation conferred with P. G. Beckett, the new general manager, at a meeting held on January 16: Grant H. Dowell, manager of the Copper Queen branch; William H. Webster, assistant manager, Copper Queen branch; Joseph P. Hodgson, manager Morenci branch; W. B. Saben, assistant manager Morenci branch; E. M. Sawyer, manager, and R. J. Hutchins, assistant manager Tyrone branch; W. G. McBride, manager of Old Dominion; H. T. Hamilton, manager of the Moctezuma Copper company; J. S. Williams, Jr., representative of the Corporation in Mexico; H. M. Gallagher, general auditor; Col. H. H. Stout, superintendent Copper Queen reduction works; E. E. Ellinwood and John Mason Ross, legal department; T. H. O'Brien, director of industrial and public relations.

BISBEE.—The Holbrook mine of the Copper Queen branch of the Phelps Dodge company has been closed down and the men working in it have been transferred to the Sacramento and Gardner mines and a few to the Czar properties of the same company. The final days of activity were spent in repairing bad ground and filling old stopes. The present high cost of mine operations was found by the Corporation not to warrant mining the Holbrook low-grade ore. A revival of the copper market will mean the immediate re-opening of the mine, however. Of the 115 employees, including foremen, not one suffered in the transfer, either in loss of position or pay. The Holbrook is the second oldest shaft in the district, the Czar alone having priority over it.

JEROME.—United Verde Extension's cross-cut on the 1500-ft. level has entered the orebody previously disclosed by a winze run down to the 1700-ft. level. The ore carries an average of 6% copper, which is of lower grade than that encountered on the upper levels. The winze shows

ore of less value on the 1600 and 1700-ft. levels. Everything is pronounced in good shape at the Verde Extension by James S. Douglas, president of the company, who says that the only obstacle to good profit is the low copper market. The Shea Copper Co. plans a scheme of development which will involve driving a tunnel for 1200 ft. to open at a depth of 675 ft. the ore developed by the 320-ft. incline shaft. The tunnel will be started soon from the canyon east of the shaft and near the line of the Mohawk claim of the Copper Chief group. For the entire distance it will follow the east and west vein of silver-copper ore which runs across the Shea ground into the Mohawk and possibly into Jerome Bisbee. The United Verde Extension smelter has agreed to treat all Shea ores worth \$12 or more and it is believed the ore extracted in running the tunnel will pay for driving it. It will be necessary to timber the tunnel until it gets well into the solid vein matter and lumber for this purpose has been ordered. Upon its arrival the company will call for bids from contractors for the driving operations. Besides opening the mine 350 ft. below the deepest present working the tunnel will provide drainage and ventilation when connection is made with the shaft.

PATAGONIA.—The Flux Mining Co. now is negotiating for the purchase of a compressor plant and power-drills which are expected to be installed in the near future. This should speed underground development considerably. With hand work, because of the hard formation, little more than a foot per day can be made. With power-drilling machines at least five feet per day would be possible. Since breaking into the vein leading to the Glory Hole orebody on the 260-ft. level, it has been determined by the directors to block out all ore to this depth in order to estimate tonnage more accurately.

CALIFORNIA

STRIKE NOT PROBABLE IN GRASS VALLEY.

GRASS VALLEY.—Ever since the strike settlement of last summer rumors have been current of dissatisfaction with the terms of the agreement between the mine owners and the employees. No official cognizance had been taken by the Mine Workers' Protective League until recently, when the members thoroughly threshed-out the subject. The League denies any and all intentions to call a strike during the life of the agreement with the mining companies. That there are a few agitators in the community is admitted. It was only after repeated rumors of a

strike that the League took the matter up. The Western Federation of Miners does not maintain an organization in this county.

NEVADA COUNTY.—The Mine Workers' Protective League market has been doing a large business almost from the opening day. There is no discrimination; the general public is served as well as the members, but no reason has been assigned as to why the mining companies have failed to fulfil the conditions of the compromise agreement of last summer, by failure to furnish food supplies as well as clothing. The companies in at least two instances are conducting miners' stores, but have gone no farther. The Register and Receiver of the Sacramento Land Office recently decided a contest over 14 acres of land near Nevada City in the Round Mountain district, instituted by Thos. J. Nolan against the Central Pacific Railroad Co. in favor of the former, on the grounds that the land in question was more valuable for mineral than for agricultural purposes.

The Le Duc Mining Co. has been at work for 11 years driving a tunnel and doing other prospecting work on a 360-acre tract just east of Grass Valley without success. The company now intends starting a raise to tap the famous Blue Lead channel known to pass through the property. The South Star in the Rough and Ready district is again to be placed in operation. A permit has been granted authorizing the South Star Mines Co. to sell 50,000 shares of the capital stock at 25 cents per share. An option has been taken on the entire amount and the sum so raised is believed to be ample to re-open and operate the property. The mine was a producer until the vein was lost and then closed for a number of years. Last summer development work recovered the vein and opened ore which assayed around \$100 per ton and so encouraged were the owners that further active mining was decided upon. A. W. Johnson of San Francisco is president of the company.

COLORADO

VALUATION OF LEADVILLE MINES.—LEADVILLE ORES TO GO TO GOLDEN CYCLE MILL.

LEADVILLE.—The assessed valuation of the metalliferous mines in Lake county, as shown by the abstract of assessment filed by the County Assessor is \$3,577,270. The report in detail shows 36,749 acres of metalliferous mining claims valued at \$1,416,885 with improvements of the value of \$933,250; assessed value of output is certified as being \$1,226,885. As a tax asset the mines are second in importance to the 93.14 miles of railroad within the county which is assessed at \$1,968,040.

A contract for the treatment of gold ore from the Little Johnny mine calling for 6000 tons monthly has been entered into by the Golden Cycle Mining & Reduction Co., of Colorado Springs. The first consignment of seven carloads was delivered at the mill last week. The Little Johnny ore which was formerly treated at the Pueblo smelter of the American Smelting & Refining Co., is worth \$30 to \$35 per ton. The handling of Leadville

ores at the Golden Cycle mill, not only means economical treatment for Leadville gold-ores, but will result in the restoration of traffic over the Colorado Midland railroad. Negotiations are reported under way to make the Colorado Midland a transcontinental line, in connection with the Chicago, Burlington & Quincy or Rock Island roads and westward from Leadville over the D. & R. G. and Western Pacific.

CRIPPLE CREEK.—A station is being cut at the 1400-ft. level of the main shaft of the Blue Flag Gold Mining Co. on Raven hill, and with the work completed a contract will be let to exploit the territory to the south and east, toward the Cresson mine. A second cross-cut will be driven north-west under the orebody opened up at the 1200-ft. level on which development ceased when sinking was started about two years ago. Other exploratory work will be done in the upper levels. The cross-cut from the 1200-ft. level carried from the Blue Flag to the Moffat tunnel for air-connection on the War Eagle property to the north, has passed through ore for a distance of 70 ft. The vein is reported as being two feet wide and samples taken by the War Eagle Consolidated company gave returns of \$24 in gold and 13 oz. silver per ton. No work will be done on this vein until the tunnel connection is made and ventilation obtained.

A call has been issued for the annual stockholders meeting of the Portland Gold Mining Co., to be held at Cheyenne on February 16 for the election of directors. No change in the present board or officials is anticipated. The Lincoln Mines & Reduction Co., following a visit of directors to the mine, will, it is announced, enlarge its operations and to this end options have been negotiated on other properties. The Gasche-process concentrating-plant, now under construction, is to be hurried to completion.

IDAHO

EMPIRE COPPER OPERATIONS.

MACKAY.—News from the Empire mine, at Mackay, indicates that since the complete change of management, about nine months ago, rapid strides have been made in improving this company's position. During the War about \$1,000,000 in dividends was paid by the former management. This was done at the expense of good mining, for development was seriously neglected. The result was that on the signing of the armistice when copper broke to 14½c. the corporation was nearly \$60,000 in debt, and most of the ore above the lowest level was exhausted.

About this time the control of the corporation was offered to the Nipissing Company, Ltd., and an extensive examination was made on behalf of the latter corporation by Morton Webber of New York. This examination occupied almost four months, as the Empire has 18 miles of underground workings. It is understood that the purchase price of the control was \$1,000,000. While the report recommended the mine as a profitable enterprise if given able management, owing to the run-down state of the property and because of the wholesale gutting, under-

gone during the War, when metal prices were abnormal, the two corporations failed to agree on a valuation and the deal collapsed.

Through the medium of the president of the Nipissing company the Empire directors employed Morton Webber as consulting engineer, and under the new management the property has been rapidly getting on its feet. One of the first things done was to employ John Linn, formerly of the Golden Cycle at Cripple Creek, as general superintendent. During the last nine months a new shaft has been sunk out of profits, and the audit of December 31 made by the accountants shows the property free from debt. Considering the fact that these important changes have been effected during a most unsatisfactory metal-market and a period of high cost of production, which has forced many properties to close-down or run at a loss, this is a highly satisfactory result.

An important change has been made in the policy of development. In the past, levels have been made at intervals of 100 ft., or even less. The distance between the Bullion level and the Cossack tunnel represents 800 ft. of undeveloped ground, through which the recurring ore-shoots pass. The new management intends to put in levels at intervals of 125 ft. By this means it is expected that the expense of one level will be eliminated. The cost of establishing one level in the Empire mine, including timbering, opening up of sill-floors, laying air-lines, and the other various items, is estimated at about \$100,000. Thus an important saving will be made. While it is possible that some ore may be lost by increasing the interval between lifts to 125 ft., the new policy would require to result in losing ore equivalent to \$100,000 before the former method would be economical. It has also been the custom in the past to turn over areas worked out on company account to lessees, and the new management feels that remnants of orebodies that may be left by reason of the increased space between levels can be extracted by lessees on a royalty basis, giving a profit to the Empire company, whereas the overhead expense in searching for remaining portions of ore, if done by the company, would probably not be profitable. During the last nine months the output from the mine has averaged 5.5% copper, 2.5 oz. silver, and \$1 in gold per ton.

MICHIGAN

U. S. BUREAU OF MINES PROGRAM FOR 1920 IN COPPER REGION.

HOUGHTON.—Efficiency rather than safety will be the principal subject of investigation by the U. S. Bureau of Mines in the Lake Superior district in 1920, according to the announcement by B. O. Pickard, district engineer. "In the past the work of the Bureau in the district has largely been concerned with teaching safety methods," said Mr. Pickard. "Now we are going to conduct a series of investigations looking toward improvement of the efficiency of mining methods."

Mr. Pickard will first investigate methods of stoping ore and later various features of underground storage of

explosives. Results of these investigations will be published by the Bureau for the general information of the mining industry of the United States. The Bureau meanwhile invites problems from the mining companies. It is at their service and wants to help in arriving at the most efficient way of solving all mining problems. In this it wants to co-operate with the companies' consulting engineers, seeking in no way to interfere with or hamper such officials.

This week the Michigan mine will commence work under improved operating conditions. Though they may



SMUGGLER-UNION MILL AT TELLURIDE, COLORADO

not be reflected in increased copper production during January, they should show in February, unless there are some unforeseen delays. Steam was turned on in the new shaft-house this week and the crushers are operating satisfactorily. The new storage-bin has been completed and will permit the accumulation of as much as 1000 tons in one lot in the rock-house. The mine is so isolated that trouble in securing cars often interferes with shipments and the new bins will take care of this situation. The property now has a working force of 230 of the highest-class miners ever employed in Ontonagon county. Conditions underground continue fair. On the 7th level,

west, the showings in the newer workings are up to standard.

Victoria will commence sinking again next week below the 28th level, through the big mass found in the lower workings. The 28th level cut into the lode January 16 and lateral work indicated good ore.

MONTANA

ACTIVITY NEAR HELENA.

HELENA.—The Blue Bird Copper Silver Mining Co. is installing a gasoline hoist on its property in the Scratch Gravel hills four miles north of here. E. R. Purnell, the superintendent, states that the shaft will be sunk to a depth of 200 ft. The Liverpool mine in Lump gulch, south of Helena, has been entirely unwatered, and shipments have begun to the East Helena smelter. A new electric hoist has recently been installed on the property, and the better hoisting facilities are expected to result in a larger tonnage of ore shipped. Other mines in Lump gulch shipping regularly are the Free Coinage and Little Nell. These mines, like the Liverpool, have recently been opened up after having lain idle a number of years. The increase in the price of silver has once more placed them in the producing class. About fifty men are employed at the Monarch mine. The new 100-ton concentrator is nearing completion, and is expected to be running before February 1. Operations have developed a large tonnage of silver-lead ore. C. E. Fryberger is manager. Another mine in this district showing great activity is that being operated by the Silver Pick Mining Co. This company has completed the installation of mining equipment capable of sinking to a depth of 800 ft. The property was formerly operated by C. L. Friederichs of Helena, and produced 170 cars of ore which gave a gross production valued at \$175,000. The ore is silver-lead carrying some gold and copper. The new company proposes to sink 200 feet.

NEVADA

RENEWED DEVELOPMENT ACTIVITY IN GOLDFIELD.

EUREKA.—The Mining & Development Co., which in October took over the Eureka Consolidated and Richmond mines in the Ruby Hill part of the district, has, in exchange for 100,000 shares of stock in the Ruby Hill Development Co., transferred to the latter company an option on 254,000 of 310,000 outstanding shares of stock. The option extends for three years. The Ruby Hill Development Co. is a Delaware corporation. It is reported that the company will reopen the old mines through the 1200-ft. Locan shaft of the Consolidated, the deepest in the Ruby Hill district. This shaft is filled with water. The surface equipment is steam driven. The production of both mines prior to 1896 is estimated at \$33,000,000 net.

GOLDFIELD.—The Yellow Tiger has \$20,000 in the treasury as a result of an assessment levied recently to provide funds for resuming work. Prospecting of the surface of the large area owned by the company has

started, principally on the Tiger and Red Lion groups in the southern part of the district. J. K. Turner, general superintendent of the Grandma, states that sinking of the shaft to 1000 ft. from the present depth of 830 ft. will be resumed. Assessment No. 6, payable immediately and delinquent February 25, has been levied for this purpose. During the past 10 months 764 ft. of work, practically all lateral, has been done at a depth of 815 ft. at a cost of \$18.37 per foot, which, according to Mr. Turner, "compares with other properties in the district much to the advantage of the Grandma". The work has resulted in the main body of the west-dipping shale being found and this is being prospected with a winze, but the east-dipping shale, which is the objective, has not been entered and no further search will be made for it until the shaft has been sunk to 1000 ft. Then a cross-cut will be driven west to it. The contact of the east-dipping shale and the latite has been prospected at many points in the district, only the Grandma, however, continuing the work. The Jumbo Extension orebody, which extended for a considerable distance above the shale, was found in exploring this contact. A winze has been sunk 100 ft. from the 910-ft. level of the Spearhead in a quartz-filled fissure in the alaskite. The fissure is from 2 to 4 ft. wide and assays as high as \$12 have been secured. The winze will be sunk to the limit of the capacity of the air-hoist being used before lateral work is started, which will be at about 150 ft. This work is being watched closely by engineers for nearby companies having deep shafts, as the finding of an important ore-shoot in the alaskite possibly would warrant further sinking of the Jumbo Extension and other shafts to the alaskite and a resumption of work in the alaskite by the Silver Pick. The Atlanta is drifting north and cross-cutting north-east on the 1450-ft. level of the Grizzly Bear shaft. The drift is following a narrow seam from which assays of \$12 are being secured and the cross-cut is being driven into the hanging wall of the vein, which heretofore has not been explored at this depth. It is rumored that the Merger plans to reorganize on an assessable basis and resume work, but A. H. Lawry, engineer for the Wingfield companies at Goldfield, says he has not been informed of such a plan. The Blue Bull is driving north from the main east cross-cut on the 250-ft. level. The vein is from 5 to 6 ft. wide and low assays are being secured. The Kewanas is driving north-east in a vein from which low assays in gold, silver, and copper are being secured. This is believed to be the same vein in which several hundred feet of drifting was done from a winze at greater depth and the drift will be continued to a point over this winze. The Atlanta, Blue Bull, and Kewanas are working in territory that practically is undeveloped.

UTAH

ALTA PROSPEROUS.—DALY-WEST AT PARK CITY DEVELOPS OREBODY.

SALT LAKE CITY.—A hearing before members of the State Board of Equalization was given the coal-mine owners and operators of the State at the Capitol building

on January 20. The meeting was called for the purpose of discussing the taxation of coal mines. H. E. Klein, of the Utah Coal Producers' Association, stated that the unmined acreage owned by 74 different companies in Carbon county and one in Emery county, has been estimated to contain 892,005,500 tons of coal. The output of coal in Utah last year was 4,537,000 tons, so on the basis of present production, the unmined areas contain about 197 years supply.

ALTA.—The tunnel being driven by the Albion Consolidated company, from the Quincy tunnel of the South Hecla mine, to tap at depth the downward extension of

at the South Hecla, the Columbus-Rexall, the Michigan-Utah, the Alta Consolidated, the Cardiff, the Louise, and the Emma mine, encourages mining men of the district to predict a summer of highly profitable operation.

EUREKA.—A new find of high-grade ore was made recently at the Tintie Standard property on the 1250-ft. level of No. 2 shaft, according to E. J. Raddatz, general manager. The orebody is situated in virgin territory, 400 ft. east from the shaft. Samples of the ore show gray copper. Regarding the significance of the find, Mr. Raddatz stated that further work would have to be done to determine the extent of the orebody. Shipments of



NEW CONCENTRATING PLANT AT THE MONARCH MINE, WEST OF HELENA, MONTANA

the Wellington orebody, is progressing satisfactorily, according to G. H. Watson, general manager. About four feet is being made each day. At present the face is about one and one-half miles from the point where it leaves the Quincy tunnel. The Wellington ore deposit, containing high-grade silver, lead, and some gold, produced at various times during the past forty years. Expense of pumping, the inaccessibility of the old workings, and the fact that a new tunnel would save a three-mile haul in the handling of ore and supplies, convinced the company that this orebody could be more expeditiously and economically developed by driving a tunnel at depth. Consequently, the Albion tunnel, which should intersect the orebody at a vertical depth of 1400 ft., 700 ft. lower than the lowest level of the old workings, was begun. Physical conditions at the South Hecla mine are very favorable. East No. 1 stope, from which a silver-copper sulphide-ore is being taken, was never in better condition. Eleven teams are hauling ore from the mine to the railroad.

More satisfactory conditions have not prevailed in this district for the past fifteen years. The excellent outlook

late from this property have been increased. During the first 15 days of January, the output of ore averaged 240 tons per day. The spur track from the Tintie branch of the Denver & Rio Grande railroad has been completed up to the company's ore-bins, which will obviate the necessity of transporting ore by team, as has been the custom in the past. Preparations are being made to increase the output of ore.

MILFORD.—Mining activity has increased materially during the past few weeks in the Beaver County mining district. The Gold Crown property, which is just over the mountain from the Moscow mine at Frisco, has been opened to a depth of approximately 500 ft. by an incline shaft. It is reported that ore has been opened on four levels and that the width of the orebody is increasing with depth; the width on the deepest level being from four to six feet, with an increase in silver and lead content. The ore carries from $2\frac{1}{2}$ to 3 oz. of silver for each unit of lead. Ten cars have been shipped which have netted from \$1500 to \$2300 per car. Present indications are that the Gold Crown ore is dipping to the west while the

Moscow orebody dips to the east. The Moscow, Red Warrior, and Combination properties in this district have been consolidated, and the new company already has men at work in the mines cleaning-up and repairing the tracks, tunnels, and shaft preparatory to active operations.

BRITISH COLUMBIA

SCHEME OF TREATMENT FOR THE SULLIVAN ORE.

NELSON.—The concentrator, designed by and erected under the supervision of W. J. Crook, of San Francisco, at the Emerald mine, near Sheep creek, has been completed. It is expected, however, that, owing to a shortage of water, it will be impossible to start operations until the spring. It had been the intention of the management to ship a quantity of crude ore to Trail this winter, but so far, there has not been sufficient snow to permit the transportation of ore. Last year 2092 tons of ore was shipped from the mine. Ore is being raw-hided from a number of properties over the light snow. The Republic, at Lemon creek, which shipped 23 tons of high-grade last year, has a number of men and four horses at work; the Ottawa mine, near Slocan City has several men and horses moving ore, as have, also, the Melon and the Neal groups, on Springer creek. The Melon shipped 92 tons last year. The old winze at the Evening Star mine, Drayton creek, is to be unwatered, and, if the report of the old-time miners that the bottom of the winze is in ore is accurate, the winze will be extended and a tunnel driven from the surface to meet the extension. Some good ore has been taken from the upper workings.

TRAIL.—Three years experimentation has culminated in a satisfactory solution of the problem of the treating of the Sullivan mine ore. The ore is a compact sulphide, being an intimate mixture of zinc-blende, pyrrhotite, and galena, with 3 to 10% insoluble. A satisfactory method has been devised, however, and a plant with a capacity of 600 tons per day has been erected. The latest plan consists of treating the crushed ore on tables, thereby removing a little of the heavy galena, at one end, and most of the gangue at the other. The middling is then subjected to wet magnetic separation for the removal of the pyrrhotite and finally to preferential flotation for the separation of the galena from the blende. A 2500-ton unit is to be built at the mine at Kimberley.

HAZELTON.—B. Smith, of the American Smelting & Refining Co., visited the Sunrise mine, on Nine-Mile mountain, to plan development work that is to be done on the property, and he left Duke Harris in charge of the operations. The Delta Copper Co. is re-opening its property on Rocher Deboeue mountain, under the supervision of W. G. Norrie Loewenthal, of the Silver Standard mine. Arthur Lindquist is manager.

VICTORIA.—The Temiskaming Mines Co., of Ontario, has bonded a considerable area of ground in the vicinity of Battle lake, Vancouver Island. It is situated about two miles from the north end of the lake, and on the western side, and geographically is in about the centre of

Vancouver Island. The property under consideration by the Ontario company is an immense belt of low-grade copper ore carrying small quantities of gold and silver. The belt is said to be 600 ft. wide and to have been traced for several miles, but only a small amount of surface stripping and open cutting has been done, and at present the extent and value of the orebody is quite problematical. The Temiskaming company will start exploration work at once.

ONTARIO

CONIAGAS NEGOTIATING FOR TRETHEWEY-COBALT.

COBALT.—The deal between Coniagas company and the Trethewey-Cobalt for the purchase of the Cobalt property of the latter is progressing. The Trethewey adjoins, and could be worked in conjunction with, the Coniagas, thus eliminating dual management. The deal involves the mill as well as the mine of the Trethewey, and if it is made the Trethewey company will doubtless concentrate effort on its Castle property in the Gowganda district.

The Crown Reserve will mine a large tonnage of low-grade ore on a plan similar to a quarry system. It is believed that in this way a substantial revenue will be realized from deposits previously looked upon as valueless. The high quotations for silver and the increasing efficiency of workmen makes the scheme feasible. During the week of January 17, the Mining Corporation shipped 221 bars of bullion, containing 221,573.01 oz. of silver. At present silver quotations, plus about 8% exchange on New York funds, the value of the consignment is estimated at \$1.40 per ounce, or \$310,202. Stellite, a steel alloy in the manufacture of which cobalt plays an important part, is being used more and more in the making of high-speed tools and cutlery. This has led to a revival of interest in some of the outlying properties in which the silver content is too low for profitable mining, but where wide veins of cobalt occur.

With silver averaging \$1.30 per ounce the mine-workers of Cobalt are receiving an average of over \$5 per day. Machine-runners are paid \$4 per day plus a bonus of 25c. per shift when silver averages 80c. per ounce or over, and an additional bonus of 25c. for each 10 points above 80c. Thus, with silver at \$1.30 per ounce, the bonus amounts to \$1.50. As long as quotations for silver remain high no further labor trouble is anticipated in Cobalt.

TORONTO.—The attention of the Government is being drawn to flagrant misrepresentations in connection with the sale of stock in mining companies. The Carveth Gold Mines, Ltd., advertising its stock in Montreal newspapers, stated that its claims were situated "in the very heart of the gold-yielding district of the Porcupine Division which is producing today the major portion of the world's gold". So far from being in the heart of the Porcupine division the Carveth properties are on the extreme edge of it about 20 miles from the gold-producing centre. The authorities are being asked to take prompt action to suppress fraudulent statements of this character.



ARIZONA

Douglas.—During the past year the Calumet & Arizona Mining Co.'s production of copper totaled 46,450,000 lb., 'made' at a cost of 13c. per pound. This figure is, of course, exclusive of excess profit taxes and a reserve for ore depletion, but as it stands is comparable with any others in the copper-producing industry.

A five-year record of production and costs shows the following:

	Production in pounds	Cost in cents
1919	46,450,000	13.0
1918	51,357,154	14.4
1917	62,397,017	13.0
1916	74,898,788	9.0
1915	65,268,910	7.4

During 1919, \$3 per share was paid in dividends on 642,453 shares. The company could have maintained the early rate of \$1 per share quarterly throughout the whole twelve-month, but preferred to keep in liquid condition. Net profits not only covered the dividends paid, but will finally show something left for surplus.

Kingman.—A recent cave on the 650-ft. level of the Gold Ore mine has revealed the ore-shoot which was opened on the 250-ft. level. The mine is to be re-opened.—Mill-tests, which are being run on the ore of the Diamond Joe mine at the flotation mill of the Arizona Molybdenum Co., have shown an extraction of 82%. At the Diamond Joe there are 8000 tons of ore on the dump which are said to assay 21 oz. per ton, in silver.

Mayer.—The recent strike of high-grade chalcopryite on the 350-ft. level of the Arizona Copper & Mining Corporation's mine is causing considerable local excitement.

Ray.—The new mill of the Gila Development Co. started operations on January 2. It is estimated that 20,000 tons of gold ore has been developed. Cross-cutting to the vein at the 200-ft. level is now under way. This property is situated three miles north-east of Kelvin. J. C. Devine is in charge.

Tucson.—R. J. Monahan and associates have purchased from J. M. Pemberton the Bondurant Gold group of claims situated in the Quijotoa district 80 miles south-east of Tucson. Development by a shaft 90 ft. deep has opened ore assaying as high as \$25 per ton in gold. The ore also carries 6 to 8 oz. in silver.

The Arizona Tucson Copper Co., nine miles south of Tucson, has made its first shipment of gold, silver, and copper ore. The new vertical shaft is down 75 ft. Cross-cutting to the orebody is to be done at the 100-ft. level. Shipments are to continue to provide funds for development.

Wickenburg.—The Gragon Mining Development Co. has started its mill, which recovers \$8 per ton in gold and silver with a considerable quantity of vanadium. This property, which is situated eight miles north of Wickenburg, has been under development for the past four years and is now in condition to continue milling for some time to come.

CALIFORNIA

Hayfork.—Big Creek Mining Co. is completing arrangements for extensive work on its placers near Hayfork. Liti-

gation affecting water rights has been settled. The holdings are among the most promising in Trinity county.

Minersville.—Following extensive prospecting new capital has become interested in Humboldt Placer Mining Co. and work will start shortly on the large holdings of the corporation. Property includes water-right and lies near Stewart's fork of the Trinity river.

Nevada City.—H. T. Rudisill has purchased the Baltimore, Dewey, and Mayflower placer-claims and Montana quartz-claim from Frank A. Garbutt. The claims are in the Eureka district and for several years have been worked with good results.—The tunnel being driven under Harmony ridge by the Penn-California Mining Co. is in 1100 ft. and is expected to reach the channel within 100 ft. The rock is excessively hard and about a month was required to drive 65 ft. The tunnel is 7 by 5½ ft. The property embraces 1000 acres and includes about two miles of the channel. Arthur W. Hoge is manager.

Sierra City.—An electric power line has been built from the station near Loganville to the Cleveland mine. All mine-equipment and 20-stamp mill is to be electrically driven. Underground conditions in the Cleveland and Monarch are reported excellent. Both mines are controlled by R. G. Gillespie.

IDAHO

Coeur d'Alene.—The Bullion Mining Co. will resume operations as soon as water flows again in the creek, possibly within 30 days, according to James H. Taylor, manager. At the time of the suspension which resulted from the cold weather last December, the face of the drift had reached a point more than 3600 ft. from the portal of the tunnel and ore had been followed for 170 ft. The body is eight feet wide and contains some copper, gold, and silver.—The Tarbox Mining Co. has demonstrated the existence of large bodies of lead-silver-zinc ore in East Coeur d'Alene. These bodies are 11 to 80 ft. wide and have been opened to a depth of 1000 ft. by a shaft and winze and considerable lateral work. Convinced that he has sufficient ore-reserves, Richard Daxon now proposes to install a concentrator.—Negotiations have been closed for the transfer of the Jim Blaine group of eight lead-silver claims on Pine creek to the Jim Blaine Silver Syndicate, recently incorporated with headquarters at Spokane. The incorporators are Matt Baumgartner, John Jahde, and W. L. Nichorster, and the articles call for a capital of \$100,000.

MISSOURI

Joplin.—The American Lead & Zinc Co., one of the leading producers of the country, has resumed operations at its No. 3 mill, south-east of Cartersville, preparatory to opening up new ground that promises production for a long period. A map of the underground workings shows practically 82 acres in one hole, except for the pillars left to hold the roof.

—The Miller Mining Co., recently organized at Webb City, has begun work at the Concord mine which it leased a few days ago. The mine has been developed recently and has an excellent 300-ton mill. The plant will be put in operation as soon as the mine has been unwatered.

NEVADA

Austin.—A seam of rich gold ore from a few inches to one foot wide is being followed in a drift being driven north from the 500-ft. tunnel of the Nevada Birch Creek Mining Co. in the Birch Creek district, 12 miles south-east of Austin. The remainder of the face is reported to be in high-grade mill ore.

Cactus.—It is expected that work will be started on a good scale by the Cactus Nevada within the next few weeks. A number of sales of claims are reported to have been made in the district recently and the new owners are waiting for the Cactus Nevada to start work before attempting to finance companies.

Goodsprings.—A new deposit of platinum-bearing ore has been found in the Boss mine, according to reports received here. The ore was found below the old workings and work is proceeding to determine its extent.

Simon District.—A cross-cut has been started south-west from the north-west drift on the 400-ft. level of the Simon Silver Lead to open the main vein beyond a fault with an estimated throw of 300 ft. This is the main fault; 500 ft. south-east of this there is another with a north-east throw beyond which drifts have been driven on the 300 and 400-ft. levels. Between these faults is the main developed part of the vein. Beyond the south-east fault the vein was found narrower and rich. The shaft, which is being sunk to 600 ft., has reached the 450-ft. point.

UTAH

Park City.—Shipments from this district for the week ending January 17 totaled 2198 tons, as compared with 2292 tons for the previous week. A noticeable increase in the output of zinc ore from the Judge M. & S. Co.'s mine was made during the current week. Mines and tonnages are as follows: Ontario, 652 tons; Silver King Coalition, 551 tons; Judge M. & S., 407 tons; Judge M. & S. (zinc ore), 261 tons; Daly-West, 219 tons; Daly Mining, 53 tons; and Naildriver, 55 tons.

Development of the upper levels and virgin territory in the Daly-West has resulted in opening up promising ground in this famous old producer. Some of the unprospected areas embrace veins and contacts covering the entire length of the property, which is approximately 3100 ft. on the strike of the veins. Several drifts and raises have been started into this new territory, three of which have developed ore of high grade. One strike in particular, made during the early part of January, shows an average value of \$125 per ton. About ten tons of this material is being mined per day. A great many permanent improvements to lessen operating costs have been completed, among them being the Daly-West shaft, which now has a direct connection with the Judge M. & S. main operating tunnel, through which the Daly-West milling-ores can be delivered to the Judge concentrating-mill for treatment.

ONTARIO

During 1919 the Coniagas company milled 71,743 tons of ore and 20,683 tons of old sand, at a total cost, including royalties, taxes, and head-office expenses, of \$398,716. Deducting \$1 per ton for re-grinding and treatment charges on the old sand, the total cost of treating the ore was \$378,033. The following table gives the per-ton cost of various items:

Mining	\$1.613
Milling	1.479
Marketing ore and concentrate	0.977
Office and supervision	0.504
Taxes and royalties	0.586
Sundry expenses	0.111
Total	\$5.270

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Ben. B. Thayer is on his way to Chile.
Clifford G. Dennis has returned from an inspection of mines at Austin, Nevada.

James W. Neill has returned from Mill City, Nevada, and has gone to Vancouver, B. C.

A. V. Thorns, of Tacotna, Alaska, is in San Francisco, this being his first journey 'outside' for 17 years.

Robert M. Keeney, consulting engineer to the York Ferro-Alloys Co., will be at York, Pennsylvania, for several weeks.

E. M. Hamilton is going to El Oro, Mexico, to advise in regard to the milling practice of the Mexico Mines of El Oro.

Eben E. Olcott, of New York, is in San Francisco, to meet his son, Lieutenant Charles Olcott, on his return from Siberia.

Forbes Rickard has been appointed consulting engineer to the London Mining & Milling Co., 'operating' at Alma, Colorado.

Herbert Stone has returned to San Francisco from Homestead, Oregon, where he was in charge of the development of the Copper Dyke mine for the past two years.

E. H. Brownell, vice-president and general manager of the A. S. & R. Co., has been visiting that company's smelters in Utah while on his way from the Pacific Coast to New York.

W. J. Loring and his son, **Edward A. Loring**, were at the Plymouth Consolidated at Plymouth, California, recently. E. A. Loring proceeded on his return trip to London, while W. J. Loring will continue on one of his periodical visits to various Mother Lode mines under his supervision.

Obituary

Robert Hollister Chapman died of pneumonia at Washington on January 11, at the age of 52. He was born at Hartford, Connecticut, and spent most of his life as topographical surveyor on the staff of the U. S. Geological Survey. His skill attracted the attention of the Canadian government, to which he was lent in 1909 for the purpose of introducing American methods in the work of the Canadian Geological Survey. He was an enthusiastic mountaineer, and during the Taft administration he was in charge of the Glacier National Park, in Montana. During the War he served with the Engineers Reserve, obtaining the rank of major and becoming assistant to General Theodore Bingham in producing airplane maps and planning the defences of New York. He was beloved by a large circle of friends and accomplished more than his share of useful work in the world.

Richard Cockburn MacLaurin, president of the Massachusetts Institute of Technology since 1909, died on January 15 of pneumonia at his home in Cambridge. During his 11 years as president, and owing largely to his influence, the Institute has received handsome endowments, which have enabled it to increase its facilities to an unprecedented extent. He was born at Lindean, Scotland, on June 5, 1870. In 1896 and 1897 he received the degrees of Bachelor of Arts and Master of Arts from St. John's College, University of Cambridge. For the next ten years he was professor of mathematics. For two years he served as dean of the law school in the University of New Zealand. In 1907 he was professor of mathematical physics at Columbia University, and had just been appointed head of the physics department, when he resigned to become president of Technology and began a new career of national usefulness.

THE METAL MARKET



METAL PRICES

San Francisco, January 27

Aluminum dust, cents per pound	05
Antimony, cents per pound	11 00
Copper electrolytic, cents per pound	19 50
Lead, 90% cents per pound	8 75-9 75
Platinum pure, per ounce	\$155
Platinum 10% iridium, per ounce	\$155
Quick-silver, per flask of 75 lb.	\$90
Spelter, cents per pound	11 00
Zinc dust, cents per pound	12 50-15 00

EASTERN METAL MARKET

(By wire from New York)

January 26—Copper is quiet and steady. Lead is dull and firm. Zinc is inactive and easy.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending
Jan. 20	132.50	79 12	Dec. 16.....131.20
" 21	132.25	79 02	" 23.....133.56
" 22	131.75	79 02	" 30.....132.50
" 23	132.50	79 87	Jan. 6.....130.80
" 24	132.50	80 25	" 13.....133.71
" 25 Sunday			" 20.....132.04
" 26	134.00	81.50	" 26.....132.58

Monthly averages

Date	1917	1918	1919	1917	1918	1919
Jan.	75.14	88.72	101.12	July	78.92	99.62
Feb.	77.54	85.79	101.12	Aug.	85.40	100.31
Mch.	74.13	88.11	101.12	Sept.	100.73	101.12
Apr.	72.51	95.35	101.12	Oct.	87.38	101.12
May	74.61	99.50	107.23	Nov.	85.97	101.12
June	76.44	99.50	110.50	Dec.	85.97	101.12

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Jan. 20	19 00
" 21	19 00
" 22	19 00
" 23	19 12
" 24	19 12
" 25 Sunday	19 12
" 26	19 25

Monthly averages

Date	1917	1918	1919	1917	1918	1919
Jan.	20.53	23.50	20.43	July	29.67	26.00
Feb.	34.57	23.50	17.34	Aug.	27.42	26.00
Mch.	36.00	23.50	15.05	Sept.	25.11	26.00
Apr.	33.16	23.50	15.23	Oct.	23.50	26.00
May	31.69	23.50	15.91	Nov.	23.50	26.00
June	32.57	23.50	17.53	Dec.	23.50	26.00

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Jan. 20	8.75
" 21	8.75
" 22	8.75
" 23	8.75
" 24	8.75
" 25 Sunday	8.75
" 26	8.75

Monthly averages

Date	1917	1918	1919	1917	1918	1919
Jan.	7.64	6.85	5.60	July	10.93	8.03
Feb.	9.10	7.07	5.13	Aug.	10.75	8.05
Mch.	10.07	7.26	5.24	Sept.	9.07	8.05
Apr.	8.38	6.99	5.05	Oct.	6.97	8.05
May	10.29	6.88	5.04	Nov.	6.38	8.05
June	11.74	7.59	5.32	Dec.	6.49	6.90

TIN

Prices in New York, in cents per pound:

Date	1917	1918	1919	1917	1918	1919
Jan.	44.10	85.13	71.50	July	62.60	93.00
Feb.	51.47	85.00	72.44	Aug.	62.53	91.33
Mch.	54.27	85.00	72.50	Sept.	61.54	80.40
Apr.	55.63	88.53	72.50	Oct.	62.24	78.82
May	63.21	100.01	72.50	Nov.	74.18	73.67
June	61.83	91.00	71.83	Dec.	85.00	71.52

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
Jan. 20	9 65
" 21	9 50
" 22	9 50
" 23	9 55
" 24	9 55
" 25 Sunday	
" 26	9 47

Monthly averages

Date	1917	1918	1919	1917	1918	1919
Jan.	9.75	7.78	7.44	July	8.08	8.72
Feb.	10.45	7.67	6.71	Aug.	8.58	8.78
Mch.	10.78	7.67	6.53	Sept.	8.33	9.58
Apr.	10.20	7.04	6.49	Oct.	8.32	9.11
May	9.41	7.92	6.43	Nov.	7.70	8.75
June	9.63	7.92	6.91	Dec.	7.81	8.40

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1917	1918	1919
Jan. 30	85.00		
Dec. 6	85.00		

Monthly averages

Date	1917	1918	1919	1917	1918	1919
Jan.	81.00	128.06	103.75	July	102.00	120.00
Feb.	126.25	118.00	90.00	Aug.	115.00	120.00
Mch.	113.75	112.00	72.80	Sept.	112.00	120.00
Apr.	114.50	115.00	73.12	Oct.	102.00	120.00
May	104.00	100.00	84.80	Nov.	102.50	120.00
June	85.00	112.00	84.40	Dec.	117.42	115.00

MONEY AND EXCHANGE

The important position of gold in the world's finances is readily seen from a study of the gold reserves of various countries and the part these reserves have played during the War. To supply credit and to meet the existing demand for more currency, nations placed their main reliance upon the issuance of bank notes, and similar obligations. This artificial expansion without an adequate gold foundation has contributed greatly to the increased prices of commodities in the world today, and the extraordinary depreciation of the currency of great nations. In fact it has been due to this condition more than to the law of supply and demand or decreased production, that we are now experiencing the 'high cost of living'.

The following tables, compiled by the Bureau of Mines from the 'Statist', illustrate in compact form what has occurred in recent years to the currency of various nations:

Table I—Gold Holdings of Various Great Banks of the World

	Prior to War	1919	Increase or decrease
England	\$195,197,000	\$557,666,000	+\$362,469,000
France	797,895,000	1,083,746,000	+\$285,851,000
Germany	304,527,000	266,469,000	-\$38,058,000
Austria-Hungary	431,276,000	52,789,000	-\$378,487,000
Italy	213,840,000	151,570,000	-\$62,270,000
Japan	106,298,000	366,580,000	+\$260,282,000
Holland	15,634,000	236,030,000	+\$220,396,000
United States	1,834,426,000	2,419,843,000	+\$585,416,000

Table II—Notes in Circulation

	Prior to War	1919	Increase or decrease
England	\$142,481,000	\$2,051,005,000	+\$1,908,524,000
France	1,149,273,000	7,153,808,000	+\$6,004,535,000
Germany	459,189,000	7,237,536,000	+\$6,778,347,000
Austria-Hungary	431,276,000	9,153,650,000	+\$8,722,373,000
Italy	322,923,000	2,012,483,000	+\$1,689,560,000
Japan	151,894,000	499,710,000	+\$347,816,000
Holland	125,728,000	411,389,000	+\$285,661,000
United States	2,434,787,000	3,569,461,000	+\$1,134,674,000

Table I indicates that of the principal contenders in the Great War, the Central Powers suffered the greatest decrease in gold holdings, while among the Allies but one nation, Italy, experienced a decrease. Table I alone, however, does not have much significance, but when studied in relation to Table II, which is a tabulation of the increase in paper money in circulation for an equal period of time, some important results appear. Thus England, against an increase of \$2,051,005,000 in gold holdings is credited with a note expansion of nearly two billion dollars. France against an increase of \$285,851,000 in gold holdings shows an increase of \$6,004,535,000 in paper currency. The ratio is greater in the case of Germany and Austria-Hungary, the former country, against a decrease of \$38,058,000 in gold reserves, indicates an increase of \$6,778,347,000 in notes, while the figures are even more startling for Austria-Hungary.

Foreign exchange quotations on January 27 are as follows:

Sterling, dollars:	Cable	3.58
	Demand	3.57
France, cents:	Cable	7.91
	Demand	7.92
Lire, cents:		6.81
Marks, cents		1.25

Eastern Metal Market

New York, January 21.

The markets are generally quiet but prices are in most cases steady. Speculation abroad is not as erratic and this has had its effect here. Domestic demand is also less.

Demand for copper has subsided and the market is easier.

Tin was heavily bought again last week but prices are uncertain.

The heavy demand for lead has slackened but prices continue high and firm.

The zinc market is quiet but steady.

Antimony is in heavier demand and higher.

IRON AND STEEL

Car-shortage is cited as one of the more important factors hindering the steel industry, to say nothing of low labor-output per man. The Steel Corporation still maintains its policy of holding to the March price schedule but many mills have gone beyond these figures. The view is expressed that the fixed prices obtaining during the War, \$11 to \$12 per ton higher, and then regarded as reasonable, are surely justifiable now because of generally higher manufacturing costs. Activity in pig-iron the last week has overshadowed that in steel.

There are indications that railroad demands will have to take their place alongside the general demand. The first definite locomotive inquiries for this year include 100 for the Union Pacific, 45 for the Great Northern, and 40 for the Missouri, Kansas & Texas. The fabricated steel trade is very promising with projects of a huge total awaiting decisions in the face of high labor and material-costs. Among the spectacular purchases of the week was the order for 87,000,000 nuts by the Ford Motor Co. distributed among a number of makers.

COPPER

Demand is light and the market is very dull. This is regarded as only natural following the heavy buying for both domestic and foreign account which prevailed a few weeks ago. Copper buying goes in waves and this is the fourth in the last 13 or 14 months. On the last movement a price as high as 23 to 23.50c. was realized. Present buying is confined to moderate amounts, depending on the needs of the consumers. Speculative dealings have been checked as far as possible for some weeks. Electrolytic copper for early delivery is quoted at about 19 to 19.25c., New York, with Lake at about 19.25 to 19.50c. The larger producers are asking 19.25c., New York, for electrolytic and 19.50c. for Lake.

TIN

The London situation continues to be a dominant factor in the market and prices have been erratic. At each recession there, buying here has been heavy. About the middle of last week a better demand appeared after a period of dullness. This resulted in the purchase of 700 to 800 tons in an extremely competitive market. Tin-plate makers were the heaviest buyers. On Monday, January 19, the market was again quiet, buyers not being attracted because of the higher asking-price of sellers who offered spot Straits at 64.25c. and futures at 64.50c. Yesterday spot Straits ruled at 64c., New York, with Banca at 63.50c. and a fair inquiry was reported. The London market is rapidly approaching the record price of £399 per ton for spot Straits, established in 1917. Yesterday this position and brand was quoted at £386 per ton. Arrivals thus far this month have been 2280 tons, of which 415 tons is credited to Pacific ports. The quantity afloat is reported as being 6330 tons.

LEAD

It is possible that the advance has been checked and if so it will be salutary. The heavy demand which has persisted recently has subsided to a marked degree. Prices are firm with wholesale lots for early delivery quoted at 8.75c., New York, or 8.50c., St. Louis. Spot lead is a little easier but is still quoted at 8.87½ to 9c., New York. Last Thursday the American Smelting & Refining Co. again advanced its quotations to 8.50c., or 8.25c., St. Louis, to more nearly keep abreast with the outside market. A steady market is expected for some time, with an ultimate recession in values as heavier supplies begin to be felt, unless the situation in Mexico, Spain, and Australia should upset conditions and cause foreign demand to seek satisfaction in the American market.

ZINC

This market is quieter than in some weeks. A better demand is reported from galvanizers who seem interested in nearby delivery but foreign inquiry has subsided to a considerable extent. It has not lost interest, however, and as soon as exchange is more stable it will undoubtedly revive. Urgent demands are evidently covered. Strikes in some Western smelters are an unfavorable factor at present and further labor troubles are not unlikely. Prime Western for early delivery is quoted at 9.30c., St. Louis, or 9.65c., New York, with some producers asking as high as 9.37½c., St. Louis. The course of the London market continues to exert an influence on values here but not to so marked an extent as in the last few weeks.

ANTIMONY

The market is much stronger. Wholesale lots for early delivery are quoted at 10.75 to 11c., New York, duty paid.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, are quoted at 31.50 to 32.50c., New York, for early delivery.

ORES

Tungsten: A rumor is afloat that certain senators have told friends in the tungsten industry that a tariff will be passed in the near future, covering this product. Just what it will be is not known, of course. In the meantime the market is very dull and prices are nominal at \$6.50 to \$15 per unit in 60% concentrates. Open quotations on ferrotungsten are not heard of, but the selling price is probably from \$1 to \$1.15 per pound of contained metal.

Molybdenum: The market is inactive and quotations are nominal at 75c. per pound of MoS₂ in regular concentrates.

Manganese: The market is strong and advancing and the ore is scarce. Makers of ferro-manganese are reported willing to pay as high as 75 to 80c. per unit for high-grade ore. This contrasts with 50 to 55c. about six to eight weeks ago.

Manganese-Iron Alloys: Domestic producers of ferro-manganese have temporarily withdrawn from the market for last-half delivery, due largely to uncertainty regarding ore-supplies and cost of production. They are out of the market for the first half and there is only a limited quantity available for the position at around \$150, delivered. The Anaconda Copper Mining Co. will soon start producing electric alloy and two or three more blast-furnaces will be producing soon. At least 500 tons of British alloy is available for delivery after March at \$150, seaboard, and perhaps more can be obtained. Spot alloy is held at \$150 to \$180, delivered, and some small sales are reported. Spiegeleisen is strong at a minimum of \$47, furnace, with one maker asking \$55. Sales of several hundred tons for domestic account are reported.

Book Reviews

Further Incidents in the Life of a Mining Engineer. By E. T. McCarthy. 400 pp. Frontispiece. George Routledge & Sons, London. For sale by 'Mining and Scientific Press'. Price, \$3 50.

This is a sequel to the 'Incidents in the Life of a Mining Engineer', reviewed in our issue of October 26, 1918. It appears—and we are not surprised—that the success of the first volume induced the publishers to beg the author to continue the story of his life and adventures, which in the first volume ended in mid-career with his return from South Africa in 1898. The proceeds of sale from the first volume went directly to the benefit of the St. Dunstan's Hostel for the Blind, and \$4000 was raised thereby. The profit accruing from this volume will be used for the same beneficent purpose. This sequel, like its predecessor, is an unaffected, straightforward story of an extraordinarily adventurous career in the remote places of the earth. Mr. McCarthy has faced death in more guises than any man we have known and he tells us all about it without frill or rhetoric of any kind. The style of the book is unpretentious to a fault, the spelling of names is wrong often, he does not trouble to round his descriptions with book learning, he omits the names of places and people where the reader's curiosity asks for them, dates are missing, and he fails to give maps, which are so helpful in a book of travel. These are the faults. They are those of a letter writer; indeed the story he tells is such as a man would write home to a friend; it is not literary, but its sincerity more than redeems its obvious defects. The matter is so good that we regret the manner is not pitched higher, but others may find this no blemish, and, for ourselves, we wish devoutly that writers of greater skill had as much real information and lively incident to record as our friend in London, a mining engineer in the first rank of the profession and a man whose true character is delightfully disclosed in the ingenuous recital of the queer things that happened to him in strange corners of the map. The first seven chapters cover his life as manager of a gold-copper mine in Chiapas, Mexico, near the Guatemalan border. These chapters alone would make a book, if treated in the customary expansive way. Then Swaziland, in South Africa, holds the reader for nine chapters. He describes how he organized and led the exodus of a mining community from Swaziland to Delagoa Bay on the eve of the Boer war. He was manager of the Pigg's Peak mine; with 20 wagons and 400 oxen, besides 45 horses, he conveyed 74 white people, including women and children, besides 200 natives, to the place of safety. The trek occupied four weeks, although the distance was only 200 miles. They arrived safely, and just in time to escape the ravages of warfare. The Far East calls, and the author tells us about his experiences in the Malay States, Borneo, and Korea. He shows an understanding sympathy with the unsophisticated natives and recites many illuminating stories about them. Twenty chapters are devoted to this part of his life. Then come travel and professional work in Siberia, where he was consulting engineer to several important copper enterprises. He was in contact with Bolshevism and its discomforts. Mexico, Siam, Borneo, Canada are the scenes of the last reminiscences. In the latter part of the book he condemns unsparingly the humbug that misrepresented the employment of Chinese coolies in the Transvaal. He crossed the straits of Tsuchima during the famous naval battle between the Russians and the Japanese. The book ends with a touching reference to the gentle lady, his wife, to whom it is dedicated. All that he writes is genuine, his style is that of 'l'homme même', which is Buffon's definition of the real thing. We commend the book heartily to the profession; it is a bully book, chuck-full

of interest. Buy it, for your own benefit and to help the Hostel for the Blind.—T. A. R.

Millions From Waste. By Frederick A. Talbot. Pp. 308. J. B. Lippincott Co., Philadelphia. For sale by 'Mining and Scientific Press'. Price, \$5.

As a result of the War, the scrap-heap has come into its own. In fact, the expression 'thrown upon the scrap-heap' no longer has its old significance, since all it probably indicates is that the article in question has simply been placed in a convenient place for storage until it can be worked over into some other useful form. The present volume deals with the reclamation of waste of all kinds, from scrap-iron to fish-offal. Although it is written from the British standpoint, the solutions that are given of the various problems are as applicable to American conditions. In general, each chapter considers some particular kind of waste product, discussing both the extent of such waste and the processes that have been developed for utilizing these products. Wastes from the kitchen, the slaughter-house, the fishing industry, the ash-can, the sewer, the metal industry, and many other branches are discussed. The treatment is popular enough to be interesting, but not so popular as to fail of being informative.

Petroleum Refining. By Andrew Campbell. Pp. 282, ill. (together with about 25 large inserts), index. Charles Griffin & Co., Ltd., London. For sale by 'Mining and Scientific Press'. Price, \$8.50.

Although petroleum refining is one of the more important of the world's industries, this is the first treatise to be published devoted exclusively to its technology. The book covers the same general lines as the second volume of Bacon and Hamor's 'American Petroleum Industry', although the treatment is not so full as in the latter book, and the present volume is based upon English and Colonial rather than American practice. The latter difference, however, is more in details such as the standard size of tanks rather than in actual processes. The first chapter, which comprises nearly one-third of the book, is devoted to methods of examination and testing of crude oil. Then follows a review of the principal departments and processes in the refinery, including methods of distribution. A chapter is devoted to specifications for tanks, stills, and other refinery apparatus. The appendix contains a bibliography of references relating to petroleum, particularly refining.

Recent Publications

Platinum and Allied Metals in 1918. By James M. Hill. I:10, U. S. Geological Survey, 1919. Pp. 9. From Mineral Resources of the United States, 1918—Part I.

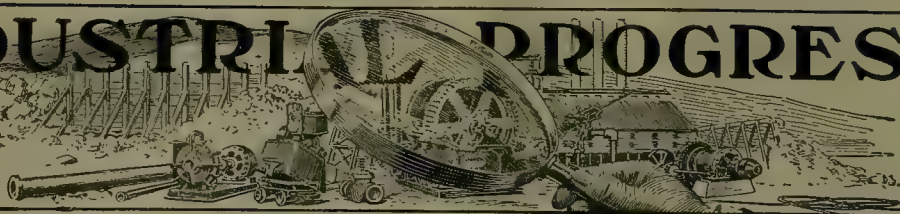
Sulphur and Pyrites in 1918. By Philip S. Smith. II:16, U. S. Geological Survey, 1919. Pp. 21. From Mineral Resources of the United States, 1918—Part II.

West Virginia Geological Survey—County Reports, 1919—Fayette County. By Ray V. Hennen and others. I. C. White, State Geologist, 1919. Pp. 946, cloth, index, ill. Case of maps (separate).

Fortieth Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior for the Fiscal Year Ended June 30, 1919. U. S. Geological Survey, 1919. Pp. 190, index, maps.

Surface Water Supply of the United States, 1917. Part VIII. Western Gulf of Mexico Basins. Nathan C. Grover, chief hydraulic engineer. Glenn A. Gray and Robert Follansbee, district engineers. Prepared in co-operation with the State of Texas. Water-Supply Paper 458, U. S. Geological Survey, 1919. Pp. 106, index, ill.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

COMMERCIAL PARAGRAPHS

Hugh L. Siegel, formerly general sales manager for the Ford Roofing Products Co., is now with Walter A. Zelnicker Supply Co., as assistant to the president.

Arthur Elliot Allen has been appointed district manager at New York for the Westinghouse Electric & Manufacturing Co. to succeed Edward D. Kilburn, who has been elected vice-president and general manager of the Westinghouse Electric International Co.

The Monel Metal Products Corp. announces the appointment of W. M. Corse as general manager. Mr. Corse was formerly general manager of the Titanium Bronze Co., and is now technical superintendent of the Ohio Brass Co. He took up his new duties on January 1.

Bulletin 1818 from the Allis-Chalmers Manufacturing Co. describes equipment for use in the converting department of copper smelters. Besides sundry types of converters, matte ladles, ingot-casting machines, cranes, and lining equipment are depicted and their best features pointed out.

Bulletin No. 60 just issued by the Mine and Smelter Supply Co. announces a change of policy in that the company will hereafter market belting, hose, and packing under its own private 'Massco' brand. The bulletin outlines the products which are to be included in the new line.

A new bulletin, No. 101, entitled 'DFC Fire Clay Products', deals with annealing-cups, cupels, crucibles, muffles, scorifiers, and special dishes and tile in an interesting and comprehensive manner. It can be had by writing to the Denver Fire Clay Co., Box 1107, Denver, Colorado.

A new bulletin entitled 'Lane Electric Cranes', has just been issued by N. B. Payne & Co., 25 Church St., New York City, agents for the Lane Manufacturing Co. of Montpelier, Vermont. The bulletin fully illustrates and describes several styles of cranes in which steel girders or heavy timbers of long-leaf yellow pine are used.

Goodwin M. Trent, manufacturing engineer, Sharon building, has issued Bulletin No. 1 describing the construction and advantages of sundry cyaniding equipment including the Trent agitator, Trent thickener, Trent replacer, zinc boxes, and slime pumps. The principles involved in the operation of the 'Universal' cyaniding machine are detailed.

A recent bulletin from the Pelton Water Wheel Co. outlines the characteristics of the various Pelton centrifugal pumps. In addition many practical data are given regarding methods of driving; arrangement of pumps in combination; installation and operation; type-selection and other valuable engineering details. Bulletin No. 10 is well worth having.

Although the Thermit process has been used since 1903 for making marine repairs and has a great many successful welds of this nature to its credit, the process till now was never officially approved by the American Bureau of Shipping, and most of the repairs were made on vessels not classed by them. It is due entirely to the unbroken record

of successful marine welds that the Bureau has accorded its official sanction to the process. According to a statement by the Metal & Thermit Corp., there has never been a single failure of a Thermit marine weld so far as it has been able to ascertain in all the years that the process has been used under this company's jurisdiction.

Glenville A. Collins, recently North-West manager for the Wellman-Seaver-Morgan Co., has resumed consulting practice as mining, civil, and mechanical engineer with offices at 1316-18 L. C. Smith building, Seattle, and branches at Portland, Tokyo, and Shanghai. Collins-Ferguson Co. at the same address will conduct domestic and foreign trade in machinery and metal products, and will undertake the construction of plants under operating guarantees.

The Southwestern Engineering Co. has issued Catalogue 'B', giving in a very attractive way the features of the 'K and K' flotation machine. The list of companies that use the machine includes some in Alaska, Chile, and Japan, in addition to some 60 others in every important mining district in North America. The machine is described in detail, and directions given for setting up. The last half of the pamphlet is given over to reports of ore-tests made by the company in its own plant at Culver City, California. Flow-sheets based on the results are shown. Commercial plants were actually constructed from designs determined, so that the material presented is of more than theoretic value. The catalogue is an extremely neat little book.

The Chicago Pneumatic Tool Co. announces the appointment of E. A. Woodworth as special railroad representative attached to the staff of the manager of Western railroad sales, with headquarters at Fisher building, Chicago. Mr. Woodworth has been for several years secretary of the Committee on Standards, United States Railroad Administration. Prior to his engagement in the Government service he was associated with the Oxbeld Railroad Service Co. and O'Malley Barre Valve Co. C. E. Laverenz who has been given a similar appointment was for several years an inspector in the Ordnance Department of the United States Navy and previously held positions with the Chicago and Northwestern and Illinois Central railroads.

Allis-Chalmers Manufacturing Co. has issued Bulletin 1532-A descriptive of the Diesel-type oil-engine which it builds. Crude or residual oils will only partly vaporize under the most favorable conditions obtainable in an engine and usually contain combustible matter that will not vaporize under any condition. The Diesel engine in overcoming this difficulty represents the highest development of the internal combustion engine. The Allis-Chalmers oil-engine combines all the economical advantages of the Diesel system, together with special constructive features essential for reliability in service. The engine is of the four-stroke cycle horizontal type with an open fuel nozzle and a low pressure starting system. These features simplify the design and overcome the chief objections of inaccessibility, uncertain piston lubrication and the clogging of the fuel nozzle, to which the older types were subject.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 220 Market St., San Francisco,
by the Decey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, FEBRUARY 7, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	179
THE HOOVER BOOM	180

What is thought at Washington. Opinions of the press. The Los Angeles 'Times', the New York 'Sun', the 'New Republic', the San Antonio 'Express'. The charge that he is not American. His work abroad as a mining engineer. His sturdy Americanism.

THE BLUE SKY LAW.....	181
-----------------------	-----

The prevention of fraud in the selling of stocks and shares. Enquiry by a committee in New York. Their report unfavorable to further legislation. Comparison with the Western States. Circular from the Commissioner of Corporations in California. Senator Kenyon's bill before Congress. Its main provisions. Severe penalties for untruthful statements. The useful work done by the Post-Office in checking wild-catting.

DISCUSSION

PUBLIC SERVICE AND PRIVATE PRACTICE

By Daniel Cross 183

Small salaries of university professors. Need for capable men. Privilege of doing outside work sometimes a consideration of consequence. The case of privately endowed institutions. Comparative value of commercial work and journeys of observation. The case of medical schools is somewhat parallel.

MOLYBDENUM AND MOLYBDENUM-STEEL

By Alan Kiscock 184

Molybdenum in tool steel. Common misapprehension as to volatilization of the element. Molybdenum has less affinity for oxygen than for either

iron or carbon. Supply sufficient to meet requirements. Future importance.

ARTICLES

THE BUNKER HILL ENTERPRISE—IV

By T. A. Rickard 185

The old diggings and modern dredging operations. An automobile trip from Kellogg to Murray by way of Wallace. The Hecla mine and James F. McCarthy. Derelict dredges at Trall gulch. Murray, himself. Adam Albach—journalist; politician; public-spirited citizen. The Yuba dredge brought from the Klondike. D. H. Ferry in charge of the dredging. Description of the dredge. How it operates. The sluice boxes. The clean-up. Return to Kellogg.

ELEMENTS OF SMELTING-PLANT DESIGN—II

By Oliver E. Jager..... 195

The blast-furnace charge. Calculations required. Silicate degree. The charge-sheet. Size of furnaces and number of units. Converter equipment. Sintering plant. Blower capacity. Charge-cars and slag-pots. Specifications. Storage capacity required. Conclusion.

THE BLUE SKY LAW..... 202

Statement must be filed with local postmaster and the Federal Trade Commissioner. Details required. Penalty provided.

STATISTICAL REVIEW 203

Production of Copper; Lead and Zinc.

DEPARTMENTS

REVIEW OF MINING 205

THE MINING SUMMARY 211

PERSONAL 212

OBITUARY 212

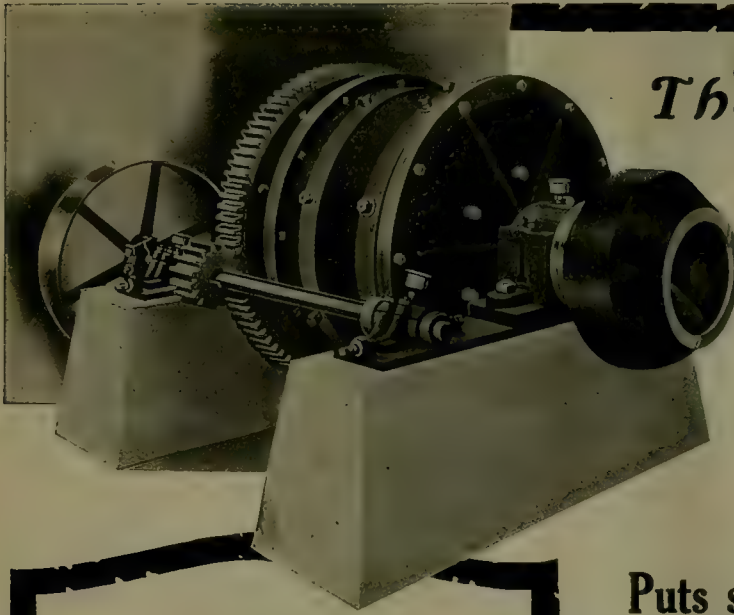
THE METAL MARKET 213

EASTERN METAL MARKET 214

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.


Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



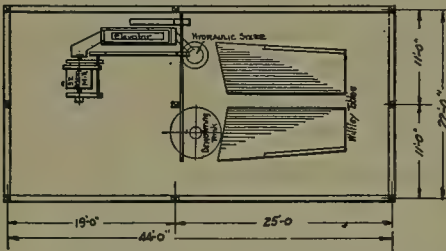
The "Baby"

**MARCY
BALL MILL**



An example of 

Baby "Marcy" Performance



Typical layout for an efficient 10 ton plant,

Feed is medium hard quartz crushed to $1\frac{1}{2}$ in., charge of balls 500 lb. (usual charge 800 lb.) Grinds through 8 mesh— $1\frac{1}{2}$ tons per hour. Operator says: "We have never had the full charge of balls in the mills as our table capacity will not care for more than $1\frac{1}{2}$ tons per hour. I feel safe in saying that with a full load of balls and the feed 1 inch and smaller the mill will handle fifty tons per twenty-four hours."

Puts small tonnage plants on a basis approaching large tonnage efficiency.

The plant putting through a low tonnage need not be under a great cost handicap compared to the big plant with its capacity in thousands of tons per day.

Not if the small plant has called in the "Baby" Marcy Mill and the "one-easy-step" system. It brings "Big" Marcy efficiency and "one-easy-step" savings to the door of the smallest tonnage plant.

The little No. 32 Marcy Mill is ideal for plants around 10 to 15 tons capacity (it can handle much more); requires 4 H.P.; has all the features of its big brothers No.'s 43, 54, $64\frac{1}{2}$, 75 and 86 Marcy Mills.

Marcy Mill capacities run from 10 to 500 and more tons per day.

Write for Bulletin 42.

The Mine and Smelter Supply Company

A Service Station Within Reach of You

DENVER

SALT LAKE CITY

EL PASO

NEW YORK OFFICE: 42 Broadway

Pacific Coast Representative—Harron, Rickard & McCone, San Francisco and Los Angeles



THE Canadian Mining Institute will meet in annual convention at Toronto on March 8 and the two following days. Mr. C. W. Knight, of the Bureau of Mines, is secretary to the local committee on arrangements. The annual meetings of this Institute are most successful affairs. Usually they are attended by a delegation from the southern side of the unfortified line that divides the American and Canadian peoples.

DURING the War the Bedford McNeill code was not permitted to be used, presumably because it could be employed effectively in evading censorship. This compliment worked to the injury of Mrs. McNeill, who now owns the copyright of the code. We are glad to state that it has been released from any restriction as to its use and we hope therefore that mining men will again avail themselves of its unquestioned good service.

GOLD is reported to have been struck in tunneling for the Hetch-Hetchy aqueduct where it crosses the Mother Lode region, but the find has no commercial value. We are reminded of the "streams that run o'er gold mines, yet gently, calmly glide and never know the wealth that shines beneath their golden tide". This was addressed by the poet to a 'Mary', whose character was symbolized thereby. Perhaps the City Engineer can find a similar maiden in the foothills that still glow with Bret Harte's romance; if not, he can use California herself for a poetic apostrophe.

UPON another page we publish the text of a resolution endorsing and pledging support to Mr. Hoover for President, passed by the Joint Council of Engineering Societies of San Francisco at a recent meeting of that representative body. A copy of this resolution has been forwarded to engineering organizations all over the United States. Needless to say, among other desirable results, the election of Mr. Hoover to the Presidency would do more to improve the status of the profession than a hundred years of conversation. Let our slogan be 'Up with the Engineers; Hoover for President'.

DIVERSE schemes of treatment, in which froth-flotation may play a part to advantage, are illustrated in the experimental work being done on the ore of the Sullivan mine in British Columbia. The ore consists of an intimate mixture of zinc-blende, pyrrhotite, and galena with a small amount of insoluble. The earlier method proposed to oxidize the pyrrhotite by a light roast, regu-

lated so as to leave the other sulphides unaltered; then to separate the galena and blende by means of preferential flotation. The more recent plan, which has been successfully carried out on a working scale, includes the wet concentration of the crushed ore so as to give a finished lead-concentrate, a middling, and a tailing to be discarded. The remaining pyrrhotite is removed from the middling by a magnetic process, after which the finished lead and zinc products are obtained by preferential flotation.

SIX weeks after the return of the striking coal miners to their work, the current rate of production is considerably in excess of that recorded during the corresponding period of the past three years. Distribution, however, is not yet normal, on account of the complete demoralization of coal movement by the railroads from November 1 to December 15. Readjustment of traffic is necessarily slow, and the difficulty is emphasized by the cold weather in the Central States. As far as actual mining operations are concerned, neither strikes nor labor-shortage is limiting production except in isolated instances, where it is due to purely local causes.

IN this issue we publish the second part of the article on the 'Elements of Smelting-Plant Design', by Mr. Oliver E. Jager. We believe that it will fulfill its purpose, which, as the author has said, is to help the younger members of the metallurgical profession to an understanding of the rationale of such work. It may also assist some of the older practitioners to analyze their own methods of procedure. Mr. Jager, at the present time, is with the British America Nickel Corporation in Ontario; he is a graduate of the Ballarat School of Mines in Australia, and formerly was on the staff of the Anaconda and Cerro de Pasco companies.

OWING to the slow economic recovery of Europe and the consequent lack of food supplies, the American Relief Association has devised a means of assisting the destitute without the direct shipment of food or the transmittal of money from the United States. Instead, warehouses to carry stocks of staple foodstuffs have been established in the European cities where distress is particularly acute. Next, the Relief Administration has arranged for the sale of orders, or food-drafts, on the warehouses; these can be sent to friends or relatives in Europe. The charge for such food-drafts will cover the

factory-cost of the food plus a reasonable margin to meet the expense of transportation and insurance. Any profit will be turned into the European Children's Fund. We give publicity to these facts because many of our readers in the mining districts will know men who are anxious to help their relatives in Europe. These should be told about the arrangement devised by Mr. Hoover for the purpose of helping the destitute without the many delays and deductions inseparable from the sending of anything to Europe at this time, not to mention the troubles arising from a fluctuating exchange. Write for particulars to the American Relief Administration at 115 Broadway, New York.

SALES of copper so far this year have not been maintained at the rate recorded during the closing weeks of 1919. During the first 20 days of January the four principal selling agencies and the Copper Export Association disposed of 170 million pounds of metal for foreign and domestic consumption. It is estimated that since the first week in November not less than 700 million pounds has been marketed, this figure representing the biggest business ever done in three months by the producers of copper in this country. Of the total, 200 million pounds went to Europe through the Copper Export Association. These sales have gone a long way to relieve the burden of unsold metal that has depressed our copper industry since the Armistice. The American Smelting & Refining Company, which at one time was embarrassed by its heavy stocks, has sold about 350 million pounds during the past three months. In this connection, the published figures of the copper sold by the Kennecott Corporation are interesting. In the first quarter of 1919 that company sold only 2,601,000 pounds; in the second, 9,044,000 pounds; in the third, 8,696,000; and in the fourth, 20,355,000 pounds. It is stated that since the close of the last quarter, the Kennecott Corporation has got rid of the remainder of its 1919 production, including 55 million pounds that had been carried as a surplus during the early summer.

CONTEMPT proceedings for alleged disregard of court injunctions have been brought before the U. S. District Court of Montana against the Butte & Superior Mining Company by the Minerals Separation company. Judge Bourquin has issued an order to show cause why the Butte & Superior company should not be punished for contempt. The hearing is set for February 10. It appears that the plaintiffs base their petition on the accounting filed recently by the defendants. In December 1918, the defendant company was enjoined from any use of oil in quantities of $\frac{1}{2}$ of 1% or less on the ore. Infringement was admitted for four months early in 1919. After the Supreme Court's mandate and the subsequent decree of the District Court, adjudging 1% of the oil as the limit under the specifications of the patent, another injunction was granted restraining the Butte & Superior company from the use of quantities of oil "equal to any fraction of 1%". The allegation now made by Minerals Separation is that the defendants infringed during the

existence of the second injunction, this allegation being based on facts disclosed in the course of the accounting. They claim that the amount of oil used was 18.6281 pounds per ton of flotation heading, or less than 1% on the ore treated. Hence the claim that the defendants made large profits by disobeying the injunction from the first of February to the end of May 1919. We look forward to the hearing of this new phase of the litigation.

LONDON is recognizing that gold is now a commodity rather than a measure of value, although still used as a reserve against notes. The altered status of the noble metal is emphasized by the fluctuation in its price as bullion, the highest recorded being 111 shillings per fine ounce, as against the 'normal' of 77 $\frac{3}{4}$ shillings, the difference indicating a 'premium' of 42%. This, it is recognized frankly, is due mainly to the adverse trade balance between Great Britain and the United States. Another factor is the heavy balance due to India, which has been a keen buyer of gold through the British government. Samuel Montagu & Company, the well-known bullion brokers, estimate the British stock of gold at £222,614,000 as against £890,930,000 held in the United States. While the world's output of gold is decreasing, the proportion produced by the British mining regions is increasing. This is a fact well worthy of attention at Washington. As to silver, the Messrs. Montagu refer to the enormous demand in China and India. The Chinese do not like paper currency, therefore official bank-notes are at a discount and the mints have been absorbing some five million taels of silver per month. The demand from China shows no abatement. The general prosperity of India is stimulating a similar demand on the part of the Indian people. These phenomena are part of the consequences of war, more particularly the lavish issue of paper money by the belligerent countries and the decreased productiveness of their peoples by reason of the disorganization caused by the War.

The Hoover Boom

A friend writes from Washington to say: "Reports coming in of Hoover's strength in the country paralyze the politicians here." No wonder; we note that many of our exchanges are declaring themselves strongly for the man of the hour. Men of both parties are eager to enlist under his leadership. The Los Angeles 'Times' says, "Herbert Hoover is a Republican . . . He is one of the few Republicans whom President Wilson called to his aid . . . He will have been already nominated by the Republican National Convention and his campaign will be under way when the Democratic National Convention meets." The New York 'Sun' says that "the boom for Hoover is going on both sides of the political fence at about the same rate of speed". The 'New Republic' says that he is "the candidate of the constructively minded people of America . . . A few weeks ago we should have supposed the hope of Hoover to be vain. There are signs that it is not vain, that if the demand is loud enough and insistent enough the next President can

be the man best fitted to be President." We might quote other leaders of public opinion; these are symptomatic. Even the gibes of Hearst and his friend Senator Reed have only succeeded in arousing public support. The silly story about Mr. Hoover being selected as presidential candidate at a luncheon in New York at which Viscount Grey was a guest has been denied categorically by Mr. Pulitzer, one of those mentioned as having been present, yet Hearst writes one of his highschool-sophomore editorials in order to exploit it in his usual cheap and nasty way. The suggestion that Mr. Hoover kotows to rank, that he is imbued with British sentiment, that he has become in any way anglicized by his sojourn in London or Australia, is amusing to those who know him. If ever there was an uncompromising American, Herbert Hoover is the man. We have seen him in Western Australia, in London, and in New York; wherever one meets him, he is so obviously, not only American, but Western American, that the suggestion of chameleonic adaptation to environment is ludicrous. As the San Antonio 'Express' says: "This gentleman, whose record as chairman of the Commission for Relief in Belgium, and as chairman of the Food Committee of the Council of National Defense, and then as United States Food Administrator, is unexcelled by the war record of any other citizen of our country, was born in the town of West Branch, and the town of West Branch is in the county of Cedar, and the county of Cedar is in the State of Iowa, and the State of Iowa is in the United States of America. He was graduated from Leland Stanford Jr. University, and that excellent school is in California, and California is another State of these United States. Also, he married a Californian—after California was admitted to the American union. Also, he is a citizen of that same California. Also, he holds several honorary doctorates from universities in such places as Rhode Island and Pennsylvania, which are pretty well established as American commonwealths. He has been very highly honored, personally, by Belgium and France, too; but, as yet, no seagreen Democrat has rebuked him as a 'Belgian', and no hidebound Republican has denounced him as a 'Frenchman'." The yellow journalist who makes love to the Sinn Feiners masquerading as 100% American, and swallows hyphens as if they were oysters, does not know a real white American when he has the chance to see one. Mr. Hoover has spent much of his time abroad; of course, he has; all the leading members of the American mining profession have received calls to go to foreign countries, and they have accepted retainers to advise European, particularly British, mining companies exploiting mineral resources in every corner of the map. Are such men as Hennen Jennings, Henry Perkins, Thomas Leggett, Charles Butters, Harry Webb, Frederick Hellmann, Pope Yeatman, William Loring, Millard Shaler, and Chester Purington any less American on account of their having practised their profession under a foreign flag? Of all of them, the most refractory to any change of character, speech, or manner, the most uncompromising American, first, last, and all the time, is Herbert Hoover. He

spent much time abroad, because his skill was in demand, but he sent his sons to California to be educated. When the War began, he dropped his private interests, first to organize relief for American refugees, and then to aid the unfortunate Belgians; but as soon as the United States entered the War, he answered the call of his own country and returned to it promptly in order to place his knowledge and experience at the service of the President. How well he did his work, it is almost unnecessary to say. The Food Administration was much the most efficient and effective department of government at Washington; it won the support of every householder and the enthusiasm of every housewife. By his works, ye shall know him. His record is open to inspection. The most competent man of his generation is indeed well fitted for the biggest task that can fall upon an American. The country is sick of petty politics and the petty men that play them; it is weary of lawyers, professors, and doctrinaires; it is tired of talk; it calls for a quiet, resourceful man, strong and incorruptible, humane but forceful, self-reliant but co-operative. Herbert Hoover is the man.

The Blue Sky Law

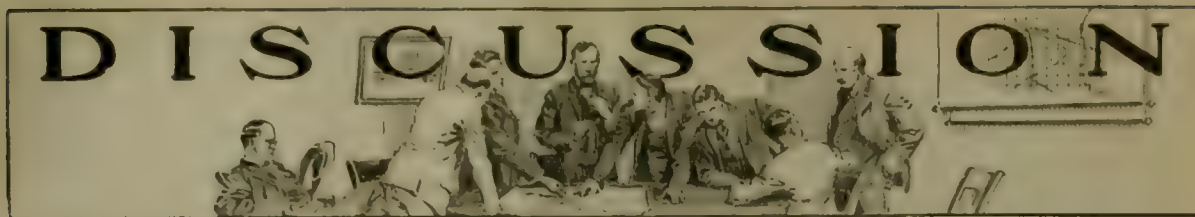
The prevention of fraudulent issues of stocks and shares is again the subject of discussion in Congress and in State legislatures. It is customary, in such discussions, to use two terms needing definition: 'blue sky' refers to the unlimited salesmanship of crooked dealers, or 'fiscal agents', who undertake to sell anything and everything from the metals in the earth beneath to the potential nitrates in the air above. 'Wild-cats' are ventures in which the element of risk exceeds the chance of profit. 'Wild-cattling' is predatory finance. The term has been borrowed by our friends on the other side of the world; it used to be said that there were no rabbits in Western Australia because the allegorical 'wild-cats', which swarmed on the goldfields, attacked them whenever they began to spread westward from South Australia. In Nevada the word 'wild-cat', like another opprobrious term, has lost much of its sinister meaning. A man will tell his friends that he is 'wild-cattling' near Tonopah when he means that he is prospecting on the fringe of a productive area. As used thus, it means an inoffensive adventure in mining, but one of slight prospects. From mining the word 'wild-cat' has been applied to every kind of risky venture, until now it may be said to involve the idea of inducing others to take an excessive risk; in short, it has a touch of the nefarious.

It appears that the Governor of New York State appointed twelve men, representing the banking business of Manhattan, to enquire into the need for curbing the marketing of worthless securities. This committee, of which Mr. A. Barton Hepburn was chairman, has prepared a report, in which the idea of registering or licensing all offerings to the public, after submission of the information requisite to prove good faith, is disapproved. The same disapproval extends, naturally, to the suggestion for subjecting the persons making such statements to civil and criminal liability. The committee feels that it "can-

not afford to adopt experimental legislation of the character adopted in our Western States"; it is of the opinion that the financial centre of the country being in New York, the State must proceed cautiously, for fear of discouraging capital from embarking in new ventures. To these conservative gentlemen, it seems unwise to impose drastic regulations upon enterprise as a whole in an endeavor to exclude a modicum of possible fraud. It is believed in New York that in some Western States it has been possible for crooks to obtain licenses and to use them as certificates of good behavior. The committee informed Governor Smith that the registering or licensing of securities is "unduly restrictive of legitimate enterprise", also that legislation cannot abolish ignorance or eliminate cupidity, besides uttering a number of other sapient aphorisms, which, we doubt not, were received with applause on Wall Street. Such applause will be echoed in some quarters on this side of the continent, for the irrepressible activities of the promoters of mining schemes have suffered from the discipline imposed upon them by the State Commissioner of Corporations. The effectiveness of such discipline depends largely upon the character of the official in whose hands the authority is placed. We know that Mr. H. L. Carnahan did well and honestly for the State of California, and we believe that his successor, Mr. E. C. Bellows, is doing likewise.

Mr. Bellows has just issued a statement on the subject. He asserts that "without wild-cattling the world would today be a much poorer place to live in". To him 'wild-cattling' is not a term of reproach; it connotes inventiveness, adventure, initiative. The suggestion of contempt now implicit in the term he attributes to the doings of the bold bad men that deceive orphans and widows. He is more amiable than correct; the word originated in misdoing and owes its kindlier touch to the easy-going good-natured spirit of the West, which pardons certain forms of queer business on account of their amusing impudence or their factitious courage. Whatever his notion of the derivation of 'wild-cattling', he does not condone its unhealthy manifestations; he is out to prevent fraud and check malfeasance. By the Corporate Securities act of California, otherwise known as the Blue Sky law, it has been found practicable "to narrow the field of operations of the smooth-tongued gentry, who have been accustomed to find their profits in the credulity of the uninformed". He finds that any effort to stop fraudulent promotions is restricted by the fact that the neighboring States do not impose similar restrictions. Therefore "the wily purveyor of scraps of paper" makes use of circular letters and newspaper advertisements. Mr. Bellows finds that some newspaper publishers are without conscience in such matters and sell their advertising columns to anyone with the price. On the other hand, the average reader is inclined to believe almost anything he sees in print. The Texas oil boom has given a great opportunity to the fakers of finance. Many newspapers are willing to publish lying advertisements and thereby help in robbing their own subscribers, the very people upon whose support they must depend. It being forbidden to use the

United States mail to defraud, the piratic promoter finds it safer to use the advertising columns of the newspapers. Mr. Bellows appeals to the daily press and reminds them of their duty to the community; he says that "the remedy for the present unfortunate condition lies first in an aroused public consciousness, which shall demand better service from the paper it patronizes". We smile, remembering the many exposures of utter lack of conscience and entire absence of any sense of decency on the part of the publishers of our San Francisco papers. At Fresno and Los Angeles he may get a response. Certainly, he would from the Portland 'Oregonian' or the Spokane 'Spokesman Review'. But Hearst, De Young, and Older! It is to laugh, sardonically. Meanwhile a bill before the United States Senate is intended to protect the public from the activities of predatory financiers. Senator Kenyon of Iowa has the matter in hand. He asserts that "the conditions which exist today are outrageous and shameful. The people of the country never had so much money to spend, and they are falling victims to these lawless speculators by the thousands. There is a perfect frenzy of buying." He maintains that legitimate business is suffering from the diversion of funds to such illegitimate speculations. It is proposed that whenever an original issue of securities is offered to the public by any corporation engaged in inter-state commerce, the issuing company shall file a statement, giving specified details of information, with the nearest United States Postmaster and with the Federal Trade Commission. It is provided that any purchaser may recover twice the amount of his subscription to the stock if any "material mis-statement is made"; also that any person using the mail to transmit any stock, knowing that the required statement has not been filed, or knowing it to be false, shall be fined not less than \$5000 or imprisoned not more than five years, or both. All such laws and regulations depend for their value and effectiveness upon the persons selected to interpret and impose them; they may be so interpreted as to endanger legitimate enterprise; therefore they should be subjected to careful scrutiny. We publish the text of Senator Kenyon's bill on another page. Anybody having criticisms to offer should send them to the Secretary of the American Mining Congress at Washington; he will see that they reach the Senate Committee on Interstate Commerce, to which Senator Kenyon's bill has been referred. For our part, we believe that the detective service of the Post-Office department has done the most effective work in checking the worst forms of 'wild-cattling'; and if the blue sky laws are given inter-state scope, it should be possible to stop a great deal of wrongdoing without interfering with the business of honest men. It may not be possible to prevent the depredation of the quick-witted and unscrupulous upon the gullible and greedy, for the proverb says truly that "a fool and his money are soon parted", but it is practicable and desirable to place handicaps on wrongdoing and to protect those whose personal honesty renders them unsuspecting of dishonesty on the part of others. Therefore we favor reasonable restrictions on mine promotion.



Public Service and Private Practice

The Editor:

Sir—With much of your editorial on this subject in the issue of January 17, I am in accord; yet there is one phase of the question, as it affects university professors, on which you did not touch, and which I believe requires thoughtful consideration. I refer to the small salaries at present being paid to professors and those of lower rank on the teaching staffs of even our greatest universities. These are generally recognized to be quite inadequate for the service rendered; indeed, in the years since the rising cost of living has become a problem to the salaried man, the salaries of professors has been the subject of much debate. Universities, however, have to do the best they can with a restricted income; endowment funds and State appropriations cannot be increased overnight; and the result is that it has become a difficult problem for the universities to attract to their teaching staffs men of the necessary calibre. Yet if our universities are to exercise to the highest degree their functions of educating and training, not only the younger men, but those of maturer years as well, and thus are to exert their proper influence upon the development of the nation, second-rate men on their teaching-staffs will not do.

The problem of the universities thus is not easy of solution; they must be able to attract men of the requisite calibre, and they have not the funds to offer salaries in competition with our industries. Of course, the generally accepted answer has always been that men devote their lives to teaching for the love of it; but this is not all. With all the love in the world for their work, men must still feed and educate their families and support them in decent conditions—not with merely bread and butter, but occasionally a little jam. If they cannot do this, they will drift into pursuits offering higher rewards. The present alarming number of resignations from the ranks of the teachers proves that when the mounting cost of the necessities of life begins to rub shoulders with their salaries, they have no recourse but to resign.

The present time therefore is not propitious for further restrictions. The problem of the universities is to make teaching more attractive—not less—so that virile and able men will be encouraged to take it up as their life's work, or, having made their choice, will be encouraged to stick to it, in order that our students may be led wisely and at last turned forth, to stand on their own feet, with the best that the nation can offer them. As you state in your editorial, men frequently accept appointments on the staffs of our universities with the un-

derstanding that they shall be allowed to practise during their vacations or other spare time; were this privilege abolished, many universities undoubtedly would lose some of their ablest men. Moreover, the question is complicated by another factor: universities are of two kinds, State and privately endowed. Although the public, that is, the taxpayers, are undoubtedly concerned in the manner in which the State universities are administered, they have no legitimate concern with the regulation of the privately endowed institutions, other than the desire of every good citizen that the country shall have adequate facilities for educating and training the coming generations. As a result of this, if our State universities were obliged to place undue restrictions on the activities of their teaching staffs, they would be at a disadvantage compared with the private universities, a disadvantage that inevitably would result in the private universities attracting the ablest men.

You will observe that I place a good deal of emphasis on expediency; yet the problem is essentially a practical one. To recall a somewhat moth-eaten dictum, it is a condition that confronts us, Mr. Editor, a condition such that our schools and universities are finding it increasingly difficult to attract and hold the best men; and these men are the very heart of a university; on their character depends the whole strength and future of our educational system.

As for the comparative merits of commercial work and journeys of observation for increasing the efficiency of teachers, an excellent debate might be staged on this point alone. I believe that both sides have valid arguments. Certainly, if universities could appropriate funds for traveling expenses and send their teachers methodically on visits to those districts or plants where they might study their specialties, it should add greatly to their breadth of vision and therefore to their ability to influence their classes wisely; on the other hand, as I cast back to my own university days, by far the best teachers that I recall were either men who had but recently left active professional work to accept teaching appointments, or else were men who were practising at the time they were teaching. When we are responsible for work, there is a certain sharpening of the perceptive faculties such as may be lacking when we are merely observers; for that reason journeys of observation may not always stimulate the teacher so well as practice in the field.

There is a possible misinterpretation of this letter that I wish to avoid. I do not believe in the socialization of industry, nor do I believe in universities or Government

bureaus conducting scientific investigations gratis for the benefit of individuals, and thus driving independent engineers and organizations from the field. I am merely defending the custom of allowing teachers, as individuals, to practise their professions co-ordinately with their teaching, if they so desire. Although at times, as you point out, they may be employed more for the prestige of their position in the university than for their own skill, yet this is balanced in other instances by the fact that many courses at universities, and even certain universities themselves, owe their reputations to the men in charge of them. A case in point is the medical schools; in all those with which I am familiar, not only the deans, but also those who hold the chairs in the different departments are physicians and surgeons actively practising, and eminent in their profession. These are not engineers; but I believe the principle to be the same.

San Francisco, January 20.

DANIEL CROSS.

Molybdenum and Molybdenum-Steel

The Editor:

Sir—In your issue of December 20, I noted an interesting article on this subject by W. E. Simpson.

In every article that attempts to set forth the valuable properties of molybdenum-steel a criticism usually follows in short order. Those in favor of molybdenum are sometimes over-optimistic and resort to superlative terms, which are barely justified, but at the same time most of the criticisms are based on ignorance of recent developments. Mr. Simpson's article is one of the best that has come to my attention. It sets forth truly the real benefits to be derived by the addition of molybdenum to steel and correctly states that it is a "valuable auxiliary".

As Mr. Simpson mentions, there are some optimists who believe that molybdenum might replace nickel. Although not quite so enthusiastic, I do know, from results secured and because this country has no extensive deposits of nickel, that molybdenum might at some time serve a strategic purpose in this connection.

Molybdenum has often been advocated for use in tool-steels. Although believing that some day its control and use for this purpose may become better appreciated, I have never considered it as a competitor of tungsten. Its value reaches into far more extensive purposes. There is one point, however, in Mr. Simpson's reference to the use of molybdenum in tool-steels that apparently is quite widespread and which I believe to be in error. It is brought out that the highly volatile nature of molybdenum causes such steels to change in chemical composition at each re-heating. The metal molybdenum itself is not volatile except at exceedingly high temperatures. Molybdenum does oxidize, however, at about 600°C. and the trioxide so formed is volatile at low temperatures.

In recent tests molybdenum has been introduced into the open-hearth bath in the early stages of melting and has remained at a constant content therein even though it was subjected for 15 hours, not only to the ordinarily severe oxidization characteristic of this operation, but

also to 'oreing down' in order to decrease the carbon content of the steel. From this and other confirmatory tests, it has been proved that molybdenum has less affinity for oxygen than either iron or carbon. Although the percentage contained in tool-steels might effect a different result, it is in my opinion doubtful whether the molybdenum would appreciably oxidize and then volatilize at each re-heating, at least not in any greater proportion than the iron itself may oxidize.

The only other point in the article to which I take exception is in regard to the possible production. Mr. Simpson makes a comparison with nickel, and says, "As to supply, no molybdenite property at present known can offer, say, 50 tons per month, whereas the nickel-bearing orebodies are so large that during the War no difficulty was experienced in extracting from one shaft alone a total of 5000 tons of ore in one day." I beg to differ with him, for I have in mind one molybdenite property that is equipped to treat 1000 tons of ore per day and produce therefrom, say, 10 tons of 60% MoS₂ concentrate per day, or 300 tons of such concentrate per month.

Although possibly this is the largest single producer, there are several others, both in this country and in Canada, equipped to bring the total production to fully 500 tons of such concentrate per month, and there are sufficient other properties that could be equipped, if the need arose, to increase the tonnage considerably. I do not know the nickel content of the 5000 tons per day mined, but since a much smaller percentage of molybdenum is used in steel, as compared to nickel, I venture to say that, expressed in tons of steel ingots (leaving out the possibility of its being a competitor as far as its properties are concerned), sufficient molybdenum could easily be produced to compare with the nickel production.

My purpose is not that of criticism; my only object is to correct a common misbelief. The British steel expert told Mr. Simpson. "The future of molybdenum depends on two factors, namely, assurance of supply and price;" it is indeed true that these two factors are most important as regards the development of molybdenum-steel. Unfortunately, heretofore, many small and sanguine mine-owners and producers have entered into contracts to deliver and have failed to live up to their agreements. This has led to the opinion that a reliable supply of molybdenum could not be depended upon, and has offered a serious drawback to progress. My only purpose then is to state that when demand does arise there are responsible concerns now able to assure an ample supply.

The matter of price is of almost equal importance to supply, but further recent and proved improvements, as, for instance, the use of calcium molybdate in the place of 'ferro' as an addition-agent to any steel-bath, are such that molybdenum may be offered at a figure that cannot fail to demand recognition. I fully agree with Mr. Simpson that molybdenum will shortly fill an important place in the ever-increasing alloy-steel industry.

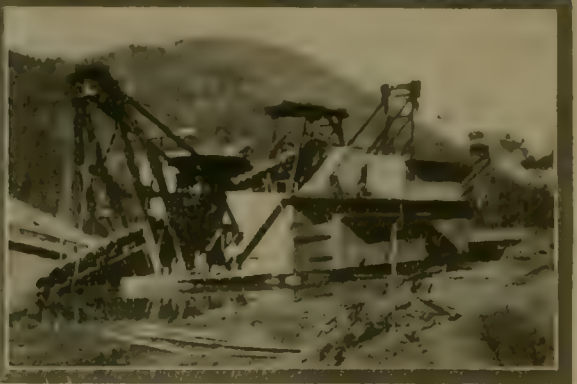
ALAN KISSOCK.

Los Angeles, January 15.

President of the
Steel Alloys Company.



ON PRICHARD CREEK



THE DREDGE

The Bunker Hill Enterprise—IV

The Old Diggings and Modern Dredging Operations

By T. A. RICKARD

On September 16 last, Mr. Stanly Easton, the manager of the Bunker Hill mine, took me in his Franklin car to Murray, so that I might see something of the old diggings and also get an idea of the upper Coeur d'Alene country, the scene of many events of romantic and industrial importance. It was the day before the opening of the season for duck-shooting, and my host was being

importuned to join other sportsmen, who reported that the lakes were black with ducks. I realized that he was most unselfish in giving me his company when he might have been doing something so much better. "Get the limit in ten minutes!" was wafted on the wind as our car throbbed into propulsive motion.

The road fringing the south fork of the Coeur d'Alene



PRICHARD CREEK; MURRAY IN THE DISTANCE; DREDGE TAILING IN FOREGROUND AND THE DREDGE BEYOND THE BEND OF THE CREEK

river was excellent and the morning was fine. The water in the river was clear, but that was an ominous sign, for it indicated the idleness of the concentrating mills upstream on account of the strike, which had caused the mines to be shut-down for two months. The bed of the stream is covered with tailing, which in places has accumulated to a level above that of the road. The question arises, will this discard from the mills be re-treated some day? The answer, in part, is that the tailing at this point has been sized by the stream and the rich slime has been separated, leaving a granular material, or 'sand', which will have to undergo re-grinding before it can be submitted successfully to flotation or to any other final process of concentration. The slime has been washed down-stream and deposited in the flat above Pine creek, where it is now being dredged by suction and re-concentrated by flotation, as will be described in another article of this series.

We passed through Osburn, once the county seat, now preserved to fame by the fact that it has given its name to the big fault that crosses the valley at this point and makes a saddle in the range to our left, which is north-east. Osburn looks sad—more like a fault than a vein! As we proceeded up the main valley, Mr. Easton pointed out various mines visible from the road. Most of them are idle now, but in their time they yielded gold, silver, and lead. Some produced 'dry' ores, that is, silicious; others, good smelting ore. He mentioned names briefly famous in other days, such as the Alma and Nelly.

Just before reaching Osburn, we passed the Evolution mine, which is identified with the oldest surviving location in the Coeur d'Alene. It was located on April 30, 1885, by A. J. Prichard and his wife, Catherine. A ruined shaft-house and a fairly large dump can be seen. About 2000 ft. of driving and sinking was done on a vein containing a lenticular orebody in the thinly bedded Wallace formation. The ore consisted of galena* spattered through a lime gangue, too poor to be profitable.

Nearing Wallace, we pass the infirmary, built at a cost of \$148,295. This mining community is rich and generous. A sum of \$35,000 has been left over from the Red Cross fund and there are few that need help in the district. The river flats here are smothered with reddish tailing, through which protrude the blackened stumps of large trees, suggesting the beautiful forest that clothed the valley when the miner first invaded the mountain solitudes. Wallace, ahead of us, looks like a miniature Pittsburgh, for the morning mist is blanketing the town and preventing the smoke of domestic industry from being dissipated in the upper air.

Before entering Wallace, which is 13 miles from Kellogg, we pass the Hercules mill, to which the ore from the mine is brought over a railroad. Wallace itself is a neat and attractive town, but it must be dark and cold in winter, because it is situated in a narrow canyon, so that at the winter solstice there cannot be much sunlight in its streets. It was a mistake to choose such a site for a town, when ampler space was available not far off; but the first settlers, we may presume, either did not

expect a large settlement or pitched their tents on a summer day when the shadows were short. The broad streets are asphalted. What a difference well-paved streets and alleys make to these mining towns, as compared with the old days when the traffic passed over the natural surface and the heavy ore-wagons made holes that became filled with mud in winter and with dust in summer.

We called upon James F. McCarthy, the manager of the Hecla mine and a man representing the best traditions of the mining profession. We talked about Herbert Hoover, for it was the day of the dinner given in his honor, in New York, by the American Institute of Mining and Metallurgical Engineers. We agreed that an American with such international experience was rare, and should be retained in the national service. We also talked a little about the strike, which had closed down the Hecla, although it had not affected the Bunker Hill, but I knew that if all the managers were as enlightened and humane as Mr. McCarthy labor troubles would be infrequent.

Leaving Wallace, we turned up Nine-mile canyon, passing the Northern Pacific railroad station, and then followed the branch line that serves the Interstate-Calahan, Tamarack, and Success mines. The tailing in the creek here is black, on account of the Prichard slate in the mill-ore, indicating that we had passed out of the Revett quartzite, which encloses the orebodies of the lower valley. Two miles beyond Wallace we noted the mill and high trestle of the California Consolidated, an old property, of which Mr. Easton had charge in 1905-07. In the early days the shallow workings produced well, but deeper exploration had proved disappointing, so he concluded that the mining had been done on the wrong side of the fault, the ore above having been found on the hanging-wall side of the fault, whereas the work below had been done on the foot-wall side. The fault was *not* post-mineral. This hypothesis led to the finding of an orebody that yielded \$185,000 in profit. "A nice little operation, but it did not last long", remarked Mr. Easton. The mill was re-modeled and superintended by Oscar Nordquist, who subsequently was engaged by Stephen Birch to take charge of the Kennecott copper mill in Alaska. We pass the branch railroad line that goes to the Sixteen to One and Ole Linn mines. A spring by the roadside provokes a contemptuous reference to "the Fords that stop to take on water" from the owner of the air-cooled Franklin car. The roadway is excellent because the slate, which is the prevailing country-rock, supplies the clay needed for binding the macadam.* We are now approaching Dobson Pass. At the summit there is a benchmark of the U. S. Geological Survey, recording the altitude as 4179 ft. The view is panoramic. Mountains stretch out like tumbled giants in a geologic sleep. The nearer hills are clothed in russet and the brush is touched with autumn gold. The pine-woods have been protected from vandalism and their serried ranks stand almost unbroken. All this part of Idaho is in the Na-

*Named after J. L. McAdam, who devised this method of road-making.

tional Forest. When, in 1906, the Government sequestered the forest-land there was a loud protest at first, but this ceased when the public was won by the wise administration of the General Land Office. To Theodore Roosevelt and to Gifford Pinchot posterity will be grateful for the protection of these forests. Here and there the workings of a mine recall man's intrusion.

"Or where half-way the mountain side was furrowed

With many a seam and scar;

Or some abandoned tunnel dimly burrowed,

A mole-hill seen so far."

A great silence broods over these mountains. Man's little noises are not heard up here. Across the line into

get found in the Coeur d'Alene. It was worth \$1500, equivalent to about 80 ounces of gold. The story goes that neither partner could trust even the temporary possession of the treasure to the other, so they agreed to hack the flat disc of soft metal with an axe, thereby spoiling its greater value as a specimen.

Near the mouth of Trail gulch are three monuments to unsuccessful dredging, and it is probable that these were partly responsible for the local scepticism as to the success of the present dredge at Murray. Two of the derelict Risdon dredges started in easy ground, but their owners had neglected to ascertain whether there was any gold in the gravel. One of the dredge-masters turned



FIG. 1. MAP SHOWING THE ROUTE AS DESCRIBED

Montana are "distant hills in purple guise athrob with soft enchantment".

The road descends from Dobson Pass into a beautiful forest of white pine, fir, and hemlock, their dark foliage forming a rich background for the tamarack's autumnal livery. To one accustomed to conifers that are ever-green, the tamarack, so like the firs in summer, offers a recurrent surprise in autumn. The early falls of snow in the Coeur d'Alene do not worry the old-timer, because he knows that winter will not come until the tamarack has shed its yellow needles.

On the other side of the Pass, the road turns at the base of the mountain, where Beaver creek and a branch railroad lead to the Ray Jefferson, supposed to be a zinc-lead mine: but the mill still waits for ore. As our destination was Murray, we took the other road, following Beaver creek to Delta, where we turned up Trail gulch, passing through Myrtle and Potosi, old mining settlements. Evidence of former industry was afforded by the abandoned workings in the shallow alluvium. Potosi gulch claims the distinction of yielding the largest nug-

farmer and today reaps a richer harvest from the gold of the cornfields. When reminiscent, this disciple of Agricola, in a double sense, asserts that the superintendent of the dredging operations used to carry the clean-up in his vest-pocket, the amalgam resembling a silver thimble. The third dredge had better luck; it furrowed the gulch for half a mile, but not always down to bedrock, and when it had to dig in the shallow ground worked by the old-timers, it gave up the fight, turned around, and sank. The hull with its shingled roof could be seen from the road, resting in a pond that gave back the blue of a perfect sky. The true character of these mining operations seems to have been appreciated locally, for I was shown the tree-stump that marked a 'hold-up', meant not to steal the gold won by dredging but to get the gold coin brought hither to pay the company's employees. That the lone bandit missed the sleigh of the paymaster and instead robbed some prospective 'investors' from Boston, does not mar the point of the story.

At the head of Trail gulch is the Jenkins mill, which treated some rich gold-quartz from the Crown Point and

other veins, suggesting the source of the gold in the placer. Then comes another divide, and on the farther side is the valley of Prichard creek, the scene of early gold mining and much besides. From the top of the ridge one can see three parallel rows of gravel looking like the back of scaly saurians from the primeval slime. Listening, we heard the rumble of the bucket-line and the rattle of the boulders discharged from the dredge that had piled these rows of tailing. Blue smoke rose lazily from the burning brush, which was being removed in order to clear the ground in front of the dredge. Beyond it, eastward and a mile farther up the valley, were the weather-beaten roofs of the town of Murray. We descended smoothly, skirting a hillside adorned with autumn's coat of many colors, to which the vine-maple contributed largely, together with the huckleberry. Even richer were the red berries of the mountain ash and the blue-black clusters of the elder, just frost-bitten enough to suit the taste of the local wine-makers, whose summer supply of mild intoxicant made from the humble dandelion is now exhausted. Who said prohibition? Poor Murray! Once the centre of feverish mining activity and thronged by a hilarious mob of youthful adventurers, it lies now, old and gray, almost exhausted of its gold and of its human life, dependent upon the operations of a single dredge and hoping that its washed-out railroad may be repaired. Even the profit derived from the boot-legging pack-trains from across the neighboring border of Montana has been denied to it by the prohibition enactment, and a community in which whiskey and champagne used to be drunk with careless freedom must now perforce solace itself with the spirit distilled from the flower of the field or the fruit of the forest.

Across the valley and above the serried ranges eastward rises a bare peak, called Granite, although in fact the rock exposed is the Revett quartzite—an example of long-distance geologic observation—not mine, but that of the fellow who named it Granite peak; mine is based on a geological map. The Revett quartzite, an important terrain in the Coeur d'Alene because it encloses so many of the richest ore deposits, is named after my friend Ben Stanley Revett, a mining engineer long recognized as a leading specialist in all forms of alluvial mining. Perhaps, to be meticulous, I ought to say that the rock formation is named after a lake on the Idaho-Montana divide south-east of Granite peak. Mr. Revett proposed to divert the water into Prichard creek in order to operate a hydraulic elevator, so his name was given to the lake. The steep sides of this lake are carved from the particular quartzite to which the name of Revett has been transferred; of all the formations in this region it is the one most resistant to erosion, therefore it constitutes the crest of many conspicuous peaks, such as Kellogg, Murray, Granite, and the ridge south of them.

Turning northward, we recognized Downey peak, surmounted by another patch of bare quartzite, on which there has been established an observatory for the fire-wardens of the Forest Service. It consists of a house, 12 ft. square, with glass sides, from which, by telephone, it

is possible to give warning of forest fires over a wide range of country.

Crossing a bridge we found ourselves in Murray. By good luck the first citizen we met was Adam Aulbach, one of the best informed of the old-timers. He was at work repairing his pipe-line in front of his Fraternity Hall, so Mr. Easton stopped the car and introduced him. He plunged forthwith into reminiscences of the time when Murray was joyous with hope, and whiskey. The accompanying photograph shows Mr. Aulbach as he rested on his shovel and talked to me. He had been one of the vigilantes in Montana in 1863 and had served under General Patrick Connor in the Civil War. As a journalist, he has edited many newspapers. In 1871 he served with Henry George when that great publicist was editor of the 'Morning Ledger' in San Francisco. At his office, later, he showed me the first issue (Vol. I, No. 1) of the 'Ledger', dated August 20, 1871. He came to Murray from Eureka, Nevada, in the fall of 1883, soon after the first discoveries of gold had been made, and established the 'Idaho Sun' in 1884. He organized the Republican party in the district and helped Phil O'Rourke to start the Democrats, so as to make things lively. On the first tickets there were two ex-convicts and two men that could neither read nor write, but they were "good fellows" all the same. Two of these went to the State legislature, one was County commissioner, and the other justice of the peace. Mr. Aulbach himself spent several sessions in the Legislature as a representative from this district, and was noted for the energetic part he took in all discussions.

Between 1885 and 1888, there were 13 stamp-mills at work, but the vein-mining proved disappointing, because at a shallow depth the ore became so base that amalgamation alone did not suffice to recover the gold. Mr. Aulbach states that 40% of the gold was lost even in treating the so-called free-milling ore, because no concentrating tables were used, except one or two bumping-tables, of the type once familiar in Gilpin county, Colorado.

In 1885 Mr. Aulbach organized the vigilantes in Murray, but no hanging ensued, although the town contained plenty of 'bad' men from all over the West. They were given notice and run out of town. Besides the 'Idaho Sun', he started most of the other newspapers of the Coeur d'Alene: the Wardner 'News', the Mullan 'Tribune', the Burke 'News', and the 'Wallace Press'.

I asked him about the discovery of the Bunker Hill. He knew the locators, of course. Kellogg, who, he said, was a carpenter, a quiet man, and short-sighted, showed pieces of the outcrop to Phil O'Rourke in Dutch Jake's (Jacob Goetz) saloon in Murray, and, as O'Rourke had mined in Leadville, he recognized the lead ore. Kellogg had four pieces of galena among his samples. As to the showing of ore, Mr. Aulbach said that when he went to the lode two days after the discovery, he saw 8 to 10 inches, and 3 ft. long, of clean galena. This is probable, for by that time the locators had broken the comb of ironstone and exposed the unoxidized mineral. Con Sullivan was constable in Murray at that time. Phil O'Rourke was "a pretty smooth fellow" and "got next

to" Kellogg, who agreed to show him the discovery. Phil and Sullivan planned to go there quietly, but Flaherty (who had lost his O' apparently) started at midnight and notified others to follow—among them, Jim Wardner. However, Kellogg, O'Rourke, and Sullivan got there first, because they knew the way, and located their claims; Kellogg had not located any previously, being then tied to Cooper & Peck by the grub-stake agreement. The early development was directed by Joshua E. Clayton, a geologist well-known in the West at that time. He was killed in a stage-coach accident between Wardner and Kellogg in 1889.

At Mr. Aulbach's office I saw a copy of the 'Idaho

to take an energetic part in all movements for the public good, working for the revival of the railroad, conducting Liberty Loan drives, and keeping interest alive in the mineral resources of the Murray district, including his own extensive holdings.

Bidding Mr. Aulbach good-by, we joined D. H. Ferry, the engineer in charge of the dredging enterprise. After a delightful luncheon with him and Mrs. Ferry, we visited the company's office, which is remarkable as having been the court-house when Murray was the county-seat of Shoshone. Later it became the headquarters of the Coeur d'Alene Mining Co., the promotion of Barry N. Hillard, who was the boss of the Democratic party in



ADAM AULBACH TELLING THE WRITER ABOUT THE OLD DAYS

Sun' of August 12, 1884, in which I found this paragraph:

"There is not a single Chinaman in camp, and none should be permitted to enter while there is a white man to lift a pick and shovel."

In the same issue is an interview with A. J. Prichard, the discoverer of gold in this part of Idaho. The editor describes him as "a tall Kentuckian", and says: "He claims entire credit for discovering gold in this region, and allows none of his old camp-companions to share even a moiety of the honor."

As we left this cheerful chronicler of a by-gone day, Mr. Easton remarked: "On different issues that have arisen in Shoshone county, the old man has been mostly right." Mr. Aulbach is now the sole proprietor of the electric lighting and water supply of Murray, which he runs in lenient fashion, scarcely paying expenses, but looking to that future when Murray shall 'come back'. He is one of the few pioneers surviving in honorable circumstance, and despite his 73 years of action, continues

the county for many years up to 1890. Across the road is the former jail, now a storehouse for the dredging company's supplies.

The dredge was at work a mile below the town. It had been brought thither from the Klondike, where it had served as the No. 9 machine of the Yukon Gold Co. on the famous Eldorado creek. It was one of the first all-steel dredges, the only wood on board being the deck, housing, and gold-saving tables. The builders were the Yuba Construction Co., of Marysville, California, and it was equipped with Bucyrus machinery, all of which was transported 3000 miles to Dawson and there assembled in 1911. The dredge worked for five years and was then dismantled previous to shipment on barges down the Yukon river for 2000 miles to St. Michael, where it was re-loaded on a steamer that carried it 2500 miles to Seattle, whence it was transported by rail on flat cars to Murray, which at that time, but not now, was served by a railroad that terminated at Paragon, seven miles above the town. This line was a branch of the Oregon-Wash-

ington Railroad & Navigation Co.; it connected with the main line at Enaville. In December 1917, a few months after the dredge had been delivered, a freshet close to Murray itself washed out the track, which as yet has not been replaced.

The hull of the dredge is 44 ft. wide, 105 ft. long, and 8 ft. deep. It was built on a slope and launched end on (see Fig. 2) into the pond provided by an old elevator-pit, which was a remainder of an earlier and unsuccessful effort to exploit this alluvium. The failure of the hydraulic elevator was due, as often happens, to the coarseness of the gravel, the larger stones choking the 8-inch throat of the elevator and compelling a cessation of work while the pipe was taken apart. A mechanical elevator was tried on Bonanza creek, where I saw and described it in 1908. At that time I made a reference* to the fact that a similar machine had been tried by Henry Bryant on Prichard creek, Idaho, in 1900. Among the other devices tried here I may mention various small Evans elevators and the Nye tailing-pump, besides the ambitious attempt of Major R. L. Hopkins to unwater the deposit by means of an open drain, 12 miles long.

It needed the very best type of modern dredges to overcome the difficulties presented by this deposit, but this method was not adopted without the objection of reputable engineers, who insisted that the ground could not be dredged profitably, basing their opinion on the evidence obtained from drifts on bedrock. They realized the large proportion of the gold that lay in the clefts and crevices of the bedrock, but considered the bedrock too hard and its surface too uneven for dredging. Indeed, the ability of this powerful dredge to dig into the bedrock explains its success as compared with all the previous efforts to mine this gold-bearing channel. The gold is concentrated close to bedrock and in it; the buckets dig two feet into the bedrock, which consists of slate traversed by ribs of quartzite, and therefore presents greater difficulty than the mica-schist of the Yukon. There a 100-hp. motor sufficed to drive the bucket-line; here 150 hp. is required. There is no overburden; the depth of the deposit averages 30 ft.; it contains many boulders ranging from one to two feet in diameter.

The working end of the dredge consists of a series of 70 buckets that dig and deliver the gravel to the gold-saving machinery. Each bucket weighs nearly a ton when empty; it has a nominal capacity of $7\frac{1}{2}$ cubic feet, or half a ton of gravel, and makes a round trip in $3\frac{1}{4}$ minutes, but as it is neither filled completely each time nor moving uninterruptedly its working capacity falls far short of $7\frac{1}{2}$ cubic feet. Instead of a nominal 8000 cubic yards, the dredge digs and raises 5000 to 6000 yards per day; but even this is a remarkable performance. The buckets move as an endless chain on a frame, called the 'ladder', which is $73\frac{1}{2}$ ft. long and suspended from the gantry, which is a girder structure 41 ft. in height, of four-post trussed design and held by cables attached to the tumbler-gantry and by girder-braces. The slope of the ladder or bucket-line is varied between

0° and 49° , as required, and at either end the bucket line passes over a tumbler, on which, of course, there is a great strain, so that it is made specially strong. The lower tumbler is a manganese steel cylinder of 39 in. diameter; the upper one is hexagonal, also of 39 in. diameter.† When the gravel is discharged from the buckets, as they turn over the upper tumbler, it falls into a hopper, from which it passes directly into a revolving cylindrical screen, or trommel, 6 ft. in diameter and 30 ft. long, sloping $1\frac{1}{2}$ inches per foot. This trommel when empty weighs 6 tons; it revolves nine times per minute. Here the pebbles, sand, and clay are shaken and washed vigorously, so that the fine sifts through the screen, which has apertures of $\frac{3}{8}$ in. at its upper end and $1\frac{1}{2}$ in. at its lower end. The coarse material runs out of the trommel onto a shaking screen, the function of which is to save any nuggets that may have failed to pass through the apertures of the trommel. The fine drops upon the gold-saving tables, which consist of wooden frames crossed by riffles, these being strips of wood covered with $\frac{1}{4}$ -inch iron. Here the gold is arrested, together with the iron sand. At intervals this concentrate is collected and the gold separated by amalgamation. The waste, on leaving the shaking screen, is discharged from the dredge by means of a belt-conveyor traveling over three-piece troughing-idlers.

Now let us go on board and get a nearer view of the operations. We descend by a steel gangway and find ourselves close to the bucket-line, which is rattling, groaning, and heaving as it digs into a bank 13 ft. above the surface of the water and 22 ft. below. The machine is digging into the bank with relentless power, raising the gravel from beneath the water to a height of 30 ft. overhead, where it is dumped in recurrent crashes that mingle with the steady roar of the trommel. It is a noisy performance, bespeaking the contest between mind and matter.

We saw a cedar stump uprooted with apparent ease. The buckets, we were told, dig two feet or more into the bedrock, according to the depth to which the gold has penetrated, as determined by panning. The buckets are close-connected and made of manganese-steel throughout, the lips being replaceable. During the first nine months of the year, that is, up to the time of our visit, the dredge had excavated over a million cubic yards. Running time had averaged 86%. There is a constant urge to keep the wheels turning and to ensure continuous operation; the manager does not hesitate to incur the cost of any appliances that may contribute to this result. During the first eight months of 1919, an increase of 25.8% in total yardage was made as compared with the corresponding period of 1918, together with a 14% decrease in cost, despite the higher prices of labor and supplies. This was done, in part, by diligent attention to details of operating management and avoiding delays and make-shifts; by keeping plenty of repair-parts on hand. A compressor on board furnishes air-power for

†The tread of the tumbler is 39 in. diam., as stated, but the diameter of the flange is 62 inches.

*M. & S. P., April 10, 1909.

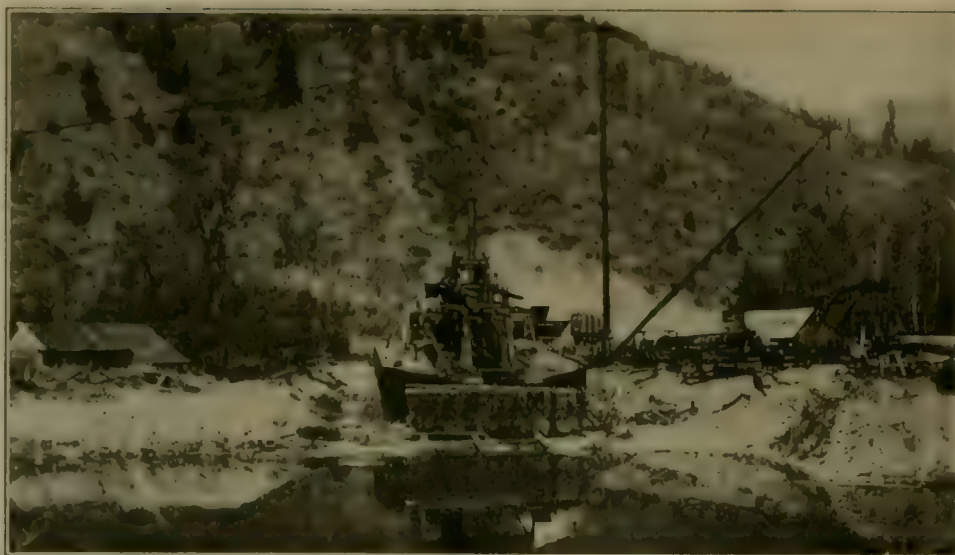


FIG. 2. THE DREDGE READY TO BE LAUNCHED; NOTE THE SCREEN OF TREES ACROSS THE BOW TO CUSHION THE HULL AGAINST COLLISION WITH THE OPPOSITE SHORE

drilling, rivetting, chipping, or grinding, when repairs are made. The dredge is equipped with a little machine-shop. An oxy-acetylene welding and cutting equipment has proved exceedingly useful; it saved its cost thirty times in the first five months, says Mr. Ferry, largely by its ability to cut manganese-steel, which no ordinary tool can do. Another time-saver has been the substitution of manganese-steel plates for ordinary steel in screens and hoppers; even the discarded manganese plates are cut by the oxy-acetylene torch and used for lining the tailing-slucies. Forged nickel-steel has been substituted for ordinary cold-rolled shafts in the ladder-rollers, which were subject to frequent breaks in cold weather. Records are kept to show the service given by the repair parts; this information includes the life, wear, fit, first cost, and cost per cubic yard of material handled.

As soon as we stepped aboard, I noticed that the hull

was low in the water, almost awash, despite the pontoons provided to increase the flotation. We were shown the new transformer-house, which is fire-proof, being made of steel plates lined with asbestos. The dredge requires 400 hp. all told, to operate the bucket-line, the winches, screens, pumps, compressor, and shop-tools. The 6600-volt current as received from the Shoshone County Power Co. is stepped down to 440 volts for use on board. Previous to the erection of lightning-arresters the power-cable was burnt during a storm, but, fortunately, the switches kicked out, so no further damage was done. The dredge is heated by steam in winter, from the middle of October to early in May. Fuel is obtained cheaply by buying the wood cut in the course of clearing the ground ahead of the dredge, this preliminary operation being done on contract. Water for the washing of the gravel is supplied by two centrifugal pumps, 8 and 10



FIG. 3. STARTING OF DREDGE ON DECEMBER 5, 1917; NOTE THE HOOD OVER THE STACKER

inches respectively, connected directly to a 75-hp. motor. The material leaving the screen is washed with unusual thoroughness.

All the cables used, for moving and mooring, are made of crucible steel and come from Roebling's Sons. These cables are kept well greased so as to prevent abrasion by the sheaves. The machinery is driven by belts, the hardest work being done by the belt, 22 in. wide and 42 ft. long, that transmits the main drive from the motor. The belt actuating the upper tumbler is 24 in. wide and 90 ft. long, running over an 8-ft. pulley.

While we were looking around, the bucket-line was stopped in order to permit lubrication. We saw how the lower tumbler is lubricated by means of grease fed from a cylinder provided with a screw worked by a handle, which, on being turned, forces the grease into the journal bearings. This device excludes grit. For under-water work a special hydraulic graphite grease is used. The rollers of the bucket-ladder are greased once a day. The upper part of the line needs only one-tenth the lubricant required by the under-water part. Mr. Ferry mentioned the fact that one of the young men whom we saw engaged in this work was Henry Henderson, a particularly efficient worker and the son of Robert Henderson, the discoverer of gold in the Yukon. The credit for the discovery is usually given to a squaw-man named George Carmack; but Carmack knew nothing about gold mining until he got the idea of prospecting from Bob Henderson, who had found gold and was mining on Gold Bottom, a tributary of Hunker creek, in 1896. Carmack, while hunting with three Indian companions, happened to visit Henderson's diggings, where he saw the gold and how it was won. Then, when returning to his camp on the Yukon, he did some prospecting on Bonanza creek and there, on August 17, 1896, made the discovery that started the great rush to the Klondike.*

Ascending to the pilot-house, or winch-room, where one man controls the huge mechanism of the dredge by a system of levers, we shook hands with Roy Darr, who had been winch-man for seven years on Dredge No. 2 of the Yukon Gold Co. at Dawson. The dredge-master, Isaac Hinkle, also had had experience in the North; he worked last on Gold Run.

The upper tumbler, which is hexagonal, is provided with replaceable ear-plates and tread-plates. The bull-wheels, actuating the tumbler, are 12 ft. in diameter and are keyed to the 16-in. shaft of this upper tumbler; they are geared by an 18-in. pinion to the intermediate shaft (7 in. diam.), which in turn is geared to the main-drive shaft (6 in. diam.), to which 150 hp. is transmitted by the 90-ft. belt. The bearings of all the shafting are bolted to the caps of the tumbler-gantry, so as to withstand heavy strains. All the moving parts of the machinery on the dredge are covered with wooden guards, to prevent accident.

The safety-platform over the main-drive shaft affords a good position for watching the buckets as they are

emptied over the tumbler into the hopper above the trommel. Three strong sprays of water in the hopper clean each bucket and prevent any gold from being carried back into the pond. The manganese-steel of which the liner-plates of the dump-hopper, like the tumbler and other parts, is made, gives a life three or four times that of ordinary steel.

Stepping to the rear of the upper deck, we saw that the dredge works on one spud and is stepped forward on stern lines. Here I may say that by reducing the length of each step, or forward advance of the boat, by nearly one-third, it has been found that the yardage is increased. Although the boat is moved more frequently, the digging from top to bottom is accomplished more quickly, because a smaller bite is made into the bank. This is important in tough ground containing occasional large boulders. The shorter step also facilitates the closer scraping of the bedrock and saves the dredge from many severe shocks, caused by reducing the bite on boulders tightly imbedded in clay, and on hard ribs of bedrock. The spud, by aid of which the step forward was formerly made, was a steel post that was dropped through a socket, or casing, to serve as an anchor to hold the dredge in position against the digging-thrust. As now used the spud is a plate-girder of box construction, 24 by 36 in., and 48 ft. long, of which 18 ft. is in the ground. The construction of this new spud is twice as strong as that of the one used at Dawson. It works against five pairs of double-coil car-springs of special design fixed in the spud-keeper or socket. The metal of these springs soon crystallizes, or suffers 'fatigue', so that they last six months only. In future they will be made of vanadium-steel. The vibration, when the dredge is digging even in comparatively loose ground, gives one an idea of the thrust that must be exerted by the buckets when they are digging in bedrock. At such times the motion of the boat is so rough that 'sea-legs' are needed.

The stacker, 85 ft. long, by which the tailing is discharged and 'stacked' to a height of 20 ft. above the former surface, is provided with an endless belt 32 in. wide and 182 ft. long. It was made by the Republic company and is 7-ply, with a reinforcement of pure rubber $\frac{1}{8}$ in. thick on the carrying side.

Watching this belt as it carries the tailing to the rear, one sees the pebbles and boulders passing in a steady stream upward, while the sand spouts forth from two sluices, one on each side of the dredge, so as to distribute this finer material laterally and thereby aid in retaining the water in the pond, which is 290 ft. wide. There is so little fine stuff in the gravel that it is difficult to maintain the pond during the dry season, because the tailing-piles are porous. Therefore the undersize from the screen is distributed in such a way as to make a temporary dam across the entire pond. During winter the stacker is covered with canvas (see Fig. 3), which fits over the framework and benefits from the heat generated on the dredge, as well as from steam-pipes that run the length of the stacker.

Going below the third deck, we noted that the screen-

*Through the Yukon and Alaska', by T. A. Rickard. pp. 189-195.

plates are provided with steel auger-bars to induce over-turning of the material and to disintegrate any clay in the gravel. Owing to the large proportion of boulders, these bars are arranged diagonally, so that the boulders may not be carried too high when the screen is revolving, and thus tear out the spray-pipe. Rings placed transversely in the screen impede the flow of gravel and ensure

ing is absent here. Mr. Ferry stated that tests show no losses from this source; when the black sand of an entire clean-up is sifted through a 40-mesh screen, it carries not a cent's worth of gold. The quicksilver is kept clean and lively by means of metallic sodium, and all the gold amalgamates readily. At the office we were shown one nugget of nearly five ounces, worth \$74.47. This was shaped

like an egg, yet it had not rolled off the rifled sluice below the shaker, despite the grade of $2\frac{1}{2}$ inches per foot. Among other specimens were smooth flat pieces resembling safety-razor blades; also a number of rough pieces with quartz still clinging to them, suggesting that they had not strayed far from their mother vein. Nor do the riffles draw the color line, for we saw fragments of silver spoons, a half-dollar minted in 1860, dimes and nickels of the 70's and 80's. That such 'savings' are



EAGLE, DECEMBER 31, 1919

thorough washing. The slots in the screens have recently been provided with an exaggerated taper, through the steel plate, so as to prevent clogging. Mr. Ferry has also designed a screen having the angle of the slots in accord with the line of movement of the particles on the curved surface of the trommel, and it has proved effective. The trommel is divided into 15 plates, any one of which, when worn, can be replaced independently of its neighbors. The shaking screen, which follows the trommel, is an innovation on the Yukon dredges, following extensive tests made by Mr. Ferry in 1911 at Dawson. Although the shaker is but 75 inches long by 44 inches wide and often covered with gravel a foot deep, it saves coarse gold, or 'nuggets', that have escaped separation in the revolving screen. Formerly it discharged upon the rubber of the stacker-belt, but the wear was excessive, giving the belt only five months life. Now it discharged upon the manganese-steel of the hopper that feeds the stacker-belt, which now lasts 15 months. The chief loss of gold is in occasional large nuggets and pieces of quartz carrying gold. The manager believes that over 95% of the gold elevated in the buckets is saved on the dredge; moreover, that this represents considerably over 90% of the gold in the deposit. The fine gold of Californian dredg-

not accidental is proved by the recent discovery of the two halves of an ancient 5-cent piece, which some spendthrift had cut in two on the bias with an axe, possibly to make change before pennies were in vogue. These two halves were found in different clean-ups on the dredge,



LOOKING DOWN THE MAIN STREET OF MURRAY, DECEMBER 31, 1919

but when put together, fitted perfectly. While dredging through the O. K. claim, the stronghold of Kid Price and his gun-men, nearly a thousand bullets of all kinds were saved in one clean-up, ranging from the gentle 0.22 up to long-necked slugs that would have suited an elephant hunter.

At 3 p.m., when the dredge was stopped for 10 minutes to grease the lower tumbler and move the swinging lines

to new 'dead-men' or anchors on shore, we were permitted to view the gold-saving tables. They are now enclosed with woven wire, the panmer (or 'gold-man') being the sole possessor of a key to this enclosure. It seems that soon after the dredge started, the appearance of coarse gold proved too great a temptation for one of the employees. He was soon apprehended, the gold recovered, and the thief sentenced. Prevention is better than cure. We saw how the small gravel and gold falls through the perforations in the trommel into a 'distributor', from which it is fed onto the 14 tables. These consist of shallow sluices 3 ft. wide and averaging 16 ft. long, the first four tables having a grade of $1\frac{1}{2}$ inches per foot, the grades of the following tables being increased to correspond with the coarser material passing over them. There are seven tables crosswise of the dredge discharging into two sluices running lengthwise, the latter two combining in a long 'tail-sluice' extending about 30 ft. beyond the stern of the boat. This arrangement of tables and sluices is duplicated on the opposite side of the dredge. The gold is arrested by Hungarian riffles placed in the sluices, 26 in. wide. The riffles consist of strips of yellow pine, $1\frac{1}{4}$ by $1\frac{1}{4}$ spaced 1 in. apart, and beveled on top so as to slope opposite to the flow of the gravel, thereby causing an eddy in which the sand remains loose while the gold is given a chance to settle. These riffles are held in a frame of clear pine of $1\frac{1}{4}$ in. cross-section; their life has been doubled by covering the tops with strap-iron $\frac{1}{4}$ inch thick, instead of $\frac{1}{8}$ inch as formerly. Thus protected they wear as well as angle-iron riffles, which have a tendency to pack hard with sand.

In order to catch any gold in the material spilled from the buckets into the well-hole, another series of tables is placed below the dump-hopper. The spill falls upon a grating of manganese-steel, so tapered that gravel small enough may pass into the 'save-all', which is a series of zig-zag sluices, with riffles, supplied with extra water from the 4-in. pump. Nearly $1\frac{1}{2}\%$ of the gold obtained comes from this 'save-all'.

Clean-ups are made at intervals of 10 to 15 days. The riffles are loosened by knocking out the wedges that hold them in place. The concentrate is shaken free and the riffles are hosed. Then the concentrate, a black iron sand associated with the gold, is shoveled and stirred before being 'streamed down', or washed successively over the tables, to one-twentieth its first volume. While this is being done, about 70% of the gold and amalgam proves sufficiently heavy to remain at the upper end of the tables, from which it is shoveled into buckets ready for retorting. The remaining 30% is then separated from about a ton of heavy sand by being washed through a sluice-box equipped with amalgamated copper plate, an amalgam-trap, and a riffle-sluice.

The figures of production are not published by the Yukon Gold Co., the owners of the dredge, but the annual report of Robert N. Bell, the State Mining Inspector, gives the gold output of Shoshone county in 1918 as \$302,000. Of this probably the major portion came from the dredge.

Leaving the dredge we walked about 50 yards south to see the steep rocky rim of a back channel; this sloped similarly to the edge of the main channel in which the dredge is digging. On the north side of the valley, and 300 ft. above it, the reddish banks of old hydraulic cuts indicate the line of the alluvial channel that was the parent of Prichard creek and contributed half its gold, the other half having been derived from the direct erosion of innumerable local veins, as is indicated by specimens of gold-bearing quartz arrested from time to time on the dredge. Two miles above the dredging ground there were gold-quartz mines, the total yield from which is reported to have been \$3,000,000. The most notable were the Golden Chest, Mother Lode, Daddy, and Yosemite.

It was time to start on the return journey. Going down the valley three miles we passed through Eagle, the pioneer mining settlement of the Coeur d'Alene, but now almost deserted. It was a peaceful scene. The few log-cabins that had survived demolition and decay seemed to be asleep in the afternoon sunshine and behind them rose the deeply brooding pine-clad mountains. Three miles farther we came to the north fork, or main branch, of the Coeur d'Alene river, and followed it to the mouth of Beaver creek, thence to Delta, where we rejoined the road over which we had traveled in the forenoon. On Dobson Pass we lingered again to enjoy the view. The lengthening shadows and the quiet of evening gave the landscape a renewed charm. Some day these mountains will relapse into their primeval restfulness, when the mines have been exhausted and the age-long concentration by natural processes has been realized in a brief harvesting by human toil.

(To be continued.)

THE production of cobalt is about 500 tons per year for the world, the use of the metal being limited by a comparative scarcity. A report of the Ontario Bureau of Mines shows that the only workable sources known are in Ontario, Missouri, New Caledonia, Belgian Congo, and Schneeberg (Germany); the most important deposits are at Cobalt, Ontario, although the Missouri mines promise to supply the needs of the United States. Though the yield at the Ontario mines is two-thirds of the world's total, the metal is only a by-product. The 1917 production of the mines at Cobalt was 155 tons nickel, 337 tons cobalt, and 2592 tons arsenic, besides 19,401,893 oz. silver. The silver represented a value of \$16,121,013 out of \$18,028,597 for the entire product. Arsenic and silver do not occur in the Missouri ore. This contains copper and lead, with much smaller averages of lead and nickel. The ore of New Caledonia is chiefly oxide, averaging about 3% cobalt. The Belgian Congo mines yield an ore with much copper and about 3% cobalt. The Schneeberg ores also are poor in nickel and cobalt, being richer in bismuth. Compounds of cobalt have served for coloring materials from a remote period. Cobalt has long been employed in the enamel, porcelain, and glass industries, but new demands have arisen in recent years.

Elements of Smelting-Plant Design—II

By OLIVER E. JAGER

THE CHARGE. It having been previously decided that 1000 tons per day is to be the rate of exploitation, or, rather, that the money resulting from the sale of the metals recoverable from this tonnage is to be the average daily earning of the concern, we may proceed with the smelting problem. The ore is assumed to be direct-smelting, and to be divided into two classes: (1) high-grade ore consisting of sulphides in a silicious gangue; (2) low-grade partly oxidized ore with an excess of iron, of which there is less developed than of ore No. 1, the ratio of the available amounts of the two ores being as 100:66. The analyses are as follows:

Ore No. 1	%	Ore No. 2	%
SiO ₂	56	SiO ₂	14.0
Al ₂ O ₃	4	Al ₂ O ₃	1.5
Fe	10	Fe	41.0
S	15	S	26.0
Cu	6	CaO	1.0
		MgO	2.0
		Cu	2.5

The first ore yields 15% fine, undersize of a $\frac{5}{8}$ -in. screen; and the second, 10%. Applying these figures to the two ores, we get, for 1000 tons per day:

Ore No. 1	600 tons =	90 tons fine plus 510 tons coarse
Ore No. 2 (66% of No. 1)	400 tons =	40 tons fine plus 360 tons coarse
Total	1000 tons =	130 fine 870 coarse

This shows the relation between the quantities of coarse ore to be smelted in the blast-furnace, and the fine ore to be sintered. A good idea of the quantity and analysis of the sinter will have been obtained previously by small-scale experiments, but we will assume that 90% of the charge to the machines is returned as sinter, thus giving a daily production of 117 tons of sinter. We are now in a position to calculate the furnace-charge, which will give us a large amount of information.

There are two or three methods of doing this,¹⁴ the most usual being the calculation of a slag of a certain silicate degree, and the calculation of a 'type' slag with definite relations between the bases present. Some methods are algebraic, and others are applicable only after the plant has been in operation for some time and the average analyses of the matte and slag have become established. For example, at a certain plant it has been found that the amount of slag produced is 75% of the weight of the charge, and that the slag carries 0.5% sulphur. Using this information, sulphur going to slag can be subtracted from the total sulphur in the charge. After deducting the sulphur volatilized, the remainder will be sulphur in matte. The matte has been found to average 24% S and 30% Fe, hence the weight of matte produced and its iron content are determined. This is a

simple and useful method after the data are once available. I am aware that a charge-calculation appears in the technical press at more or less regular intervals, but generally without sufficient explanation to enable a person unfamiliar with the process to make the calculation on some other ores. For this reason (at the risk of repetition), the present method is given. It is not new, being the 'silicate-degree' method presented in a manner somewhat different from that in the textbooks.

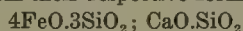
When fluxing a silicious charge, as in the present case, it is usual to make a slag of a silicate-degree as high as compatible with good running. Lime is generally combined as a bi-silicate, while the sesqui-silicate of iron is preferred to the mono-silicate. On the other hand, when a basic charge has to be fluxed, the sesqui- or mono-silicate degrees are adopted, so as to reduce the amount of barren flux to the lowest amount. The formation temperatures and necessary superheat of any contemplated combination, as shown in Hofman's tables, must be considered carefully, or a freeze-up may result. The small amounts of alumina present may be neglected, although, without going into the question of the rôle played by it, alumina is considered here as an acid for the purpose of illustration. In that case, it is usual to multiply the percentage of alumina by 0.6 and call the result silica. Similarly, the percentage of magnesia is multiplied by 1.4 and called lime. These factors can be easily calculated. For example, magnesia as lime: $MgO = 40$; $CaO = 56$. Then $40:56::1:1.4$.¹⁵ These substitutions must be employed with care; they are not always to be recommended, especially if some troublesome element or combination is present. In case of doubt, it is safer to calculate each element separately. In actual operation, the analytical results must be compared with the calculated; if there is a chronic discrepancy, the inference is that there is something wrong with the premises, and steps must be taken to re-arrange the calculation. After working with a particular combination of ores for some time, it is often found that purely empirical factors can be evolved for various uses, such as with alumina and zinc, for impurities taken up by the matte, etc. The relative amounts of the ores and of the sinter being already fixed, the other ingredients of the charge must be varied to give the required slag. The furnaces will have to run for the first day or two without converter-slag, as none will be available until after the converters have commenced to blow. Converter-slag is included in the present calculation, however, as it will be a regular constituent of the charge under normal conditions. The 200 tons appearing on the

¹⁴Hofman, 'General Metallurgy', p. 484; 'Metallurgy of Copper', pp. 185 and 202; Barr, op cit., p. 192.

¹⁵Barr, op. cit., p. 179; Hofman, 'Metallurgy of Lead', p. 332.

charge-sheet (Table 2) is a purely arbitrary quantity and is subject to alteration, as will be explained later.

Having brought alumina and magnesia to their equivalents, and multiplied all the quantities out (with the exception of the lime-rock) to the nearest whole number on the slide-rule, commence with the copper column. From the copper 6% is deducted, thus assuming a recovery of 94%. For practical purposes, matte is taken as $\text{Cu}_2\text{S} \cdot \text{FeS}$, from which we get: $\text{Cu} \div 4 = \text{S}$ with Cu, and $\text{S} \times \frac{7}{4} = \text{Fe}$ with S. Copper, having a greater affinity than iron for sulphur, will first take up all the sulphur it requires. The copper in the matte, with its corresponding sulphur, being calculated, pass now to the sulphur column. With a charge of this nature, plenty of blast, and a furnace having no bosh but a slight taper from tuyeres to feed-floor, a good oxidation of sulphur may be expected, say, 80%. It is better to under-estimate the volatilization than to over-estimate it. Sulphur volatilized is subtracted from total sulphur. It will be noticed that the sulphur in the converter slag is added afterward, as it is regarded as not being subject to volatilization. Thirty-eight tons of sulphur now remain, from which is subtracted the 12 tons with the copper in the matte, leaving 26 tons to carry 46 tons of iron into the matte. These two last items are now entered with the other constituents of the matte, and the whole added, giving 131 tons of matte, which it is safe to increase by 5% to cover absorption of any impurities such as small amounts of zinc or lead (if present), and to allow for irregularities in the make-up of the matte, since its composition cannot be considered as definitely represented by the formula $\text{Cu}_2\text{S} \cdot \text{FeS}$. There is $\frac{47}{138} = 34\%$ copper in the matte. Since the iron that goes into the matte is not available for the slag, it is subtracted from the total iron. The calculation now shows that we have 458 tons of silica, 304 tons of iron, and 16 tons of lime to form the slag. It is at this point that the method of the 'silicate-degree' is applied to produce the required slag, namely, a sesquioxide of iron and a bi-silicate of lime. All available iron is first combined with the proper amount of silica, and the remaining silica is then fluxed by lime. The necessary factors are found in Balling's tables,¹⁶ or can be calculated from their respective formulas:



$$1 : 0.63; 1 : 1.077$$

To calculate the lime-rock required:

$$\text{Fe} \times \frac{9}{7} = \text{FeO}. \quad 304 \text{ tons Fe} = 391 \text{ tons FeO}$$

$$\text{Silica fluxed by FeO} = 391 \times 0.63 = 246$$

$$\text{Silica fluxed by CaO} = 16 \times 1.077 = 17$$

Total 263 tons

Total silica = 458 tons; $458 - 263 = 195$ to flux by lime-rock. $195 \div 1.077 = 181$ tons CaO required. The lime-rock contains 50.4% available CaO, so that the lime-rock required = $\frac{181}{50.4\%}$, or 359 tons.

'Available' lime is the amount remaining after the

silica in the lime-rock has been fluxed. To calculate it the procedure is the same as before. Since it contains 1% Fe, this will flux $1 \times \frac{9}{7} \times 0.63 = 0.8$ silica, leaving 1.7 to flux with lime; $\frac{1.7}{1.077} = 1.6$; $52 - 1.6 = 50.4\%$ available lime.

This 359 tons of lime-rock is now entered on the sheet, and the amounts of silica, iron, and lime put down. The result of the final addition is that we have 467 tons of SiO_2 , 396 tons of FeO, and 203 tons of CaO to form the slag. It is usual to say that the silica, iron oxide, and lime in the slag will add up to 90%, but if other bases have been included, as in the present case, the total will be more, say, 95%. Dividing 1066 by 95% gives 1122 tons of slag formed. The quantities 467, 396, and 203 are then each divided by 1122 to obtain the percentage of SiO_2 , FeO, and CaO, respectively, in the slag. To prove the silicate-degree correct, proceed as follows: $(18.1 \times 1.077 + (35.3 \times 0.63)) = 41.7$, which is a sufficiently close check.

In calculating the ratio of concentration, only new materials are considered. Any matte or other cupriferous revert on the charge must be allowed for, as it has been produced from some previous charge. It would be incorrect to say that 987 tons of raw material (ore and sinter) produced 138 tons of matte, as 12 tons of this matte came from the 4 tons of copper contained in the converter slag; the new matte produced from the raw material is therefore 126 tons, so that 7.8 tons of raw material make one ton of matte. Sulphur on the charge means the ratio of sulphur available as fuel to the total weight of the charge. Since 142 tons of sulphur are burned off, the percentage will be $\frac{142}{1546} = 9.2\%$. Copper on the charge means the proportion of total copper in the charge. The production of slag is found to be 72.6% of the weight of the materials charged. Coke is not included in any of these totals, as it is fuel, and is always considered an extra. The matte-fall is 11%; this means that 11% of the material flowing from the tap-hole is matte. Some charge-calculations show matte-fall as the ratio of matte to total charge. This may be a useful figure to have, but it is not matte-fall, which is the ratio of matte to the matte-plus-slag produced by the furnace. The fluxing of coke-ash is a refinement not generally adopted in copper work, so it is not considered here.

We are now in a position to get information from this charge-sheet. From the amount of sulphur present, it is clear that the ore-mixture is amenable to treatment by the semi-pyritic process. The sulphur on the charge (volatile sulphur), being about 9%, signifies a considerable generation of heat, so that the coke can probably be reduced from the estimated 10%, though it would be safer to estimate the coke-requirements for this tonnage at 155 tons per day. The matte-fall is sufficient to keep the tap-hole in good condition for free running, and the matte is suitable in grade for treatment in basic-lined converters, which will have to treat 138 tons of matte per day. The ratio of concentration is a little low, but may be left at this point for the present. It happens that

¹⁶Liddell, 'Metallurgists & Chemists' Handbook', p. 511.

the slag analysis has come out satisfactorily as regards the relative proportions of iron and lime; a slag of this analysis should run well. The production of slag will be 1122 tons per day. To treat 1000 tons of ore, 1546 tons of charge must go through the furnaces. The 138 tons of matte contains 46 tons of iron that must be slagged in the converters. The converter slag is estimated to contain 44% Fe, so that the daily quantity of slag made is 105 tons. As this slag will contain 25% SiO_2 , there will be required 26 tons of silica, or, say, 28 tons of quartz at 93% SiO_2 . The quantity of converter slag being about one-half that taken on the charge-sheet, there must be a

ondaries. Of the 12% apparently lost at the converters, there is, of course, a good proportion recovered in the converter slag, cleanings, and flue-dust. No account has been taken here of the last two items, and for the sake of simplicity, any consideration of the precious metals has been purposely omitted.

It is apparent, of course, that the above is not the only solution of the problem. The correct method will be that which shows the greatest final profit. If power is expensive, it would be advisable to consider the making of a higher-grade matte (with a consequent higher slag-loss), which would call for more sinter and less of No. 2 ore on

TABLE 2 CHARGE SHEET

NAME	TONS	$\text{SiO}_2 + \text{Al}_2\text{O}_3$		Fe		$\text{CaO} + \text{MgO}$		S		Cu	
		%	Tons	%	Tons	%	Tons	%	Tons	%	Tons
Ore No 1	510	50.4	298	16	82			15	77	6	31
Ore No 2	360	14.9	54	41	140	3.8	14	26	94	2.5	9
Sinter	117	48.0	56	27	32	1.3	2	6	7	5.5	6
									178		
									Less 80% 142		
									36		
Converter slag	200	25.0	50	44	88			1	2	2	4
			458		350		16		38		50
					46				12		Less 6% 3
					304 = 391 FeO				4) 2		4) 47 Cu in matte
Lime-rock	359	2.5	9	1	4	52	187		6.5		12.5 with Cu
	1546		467		308 = 396 FeO		203		7		46 Fe in matte
Coke (10%)	155								46 Fe in matte		26.5 with Fe
									matte		131
										Plus 5% 7	
											138 matte @ 34% Cu
Calculation of lime-rock required				Slag				Matte-fall:			
16 x 1.077 = 17				467				138			
391 x 0.63 = 246				396				1122 + 138 = 117			
263				203				Ratio of concentration:			
458 - 263 = 195 SiO_2 to flux				1066 - 95% = 1122 slag = 72.6% of charge				4 tons Cu in converter slag			
195 ÷ 1.077 = 181 CaO				Analysis SiO_2 41.6%				= 12 tons matte @ 34% Cu			
181 ÷ 50.4% = 359 lime-rock				FeO 35.3				138 - 12 = 126			
				CaO 18.1				987 (ores + sinter) ÷ 126			
				95.0				= 7.8 into 1			
Sulphur on the charge				142				Copper on the charge			
1546 = 9.2%				50				1546 = 3.2%			

re-calculation using the smaller figure instead of the 200 tons. The result is that while the composition of the slag is not materially altered, 20 tons more lime-rock must be used, making the daily requirement of lime-rock 379 tons. As the amount of converter slag available will vary from day to day, this discrepancy in the preliminary calculation is of little importance, except to emphasize the fact that sufficient lime-rock must be arranged for. Of the 47 tons of copper contained in the matte, about 88% will appear as blister copper, giving a daily production of 41.36 tons, thus giving the total recovery of about 90% for the whole plant. It is difficult to give recovery figures that will be useful, as there are many variables to be considered. It is assumed that the flue-dust and converter slag will be treated as fast as they are made, so that there may be no undue amount of copper tied up in these sec-

the charge. This would require more fine ore than is available under present conditions, so that the cost of crushing some No. 2 ore would have to be gone into. Making higher-grade matte would produce less converter slag, the decrease of which on the furnace-charge has been known, in certain cases, to have a bad effect on the speed of the furnaces. High-grade matte permits less ore to be smelted in the converters, which brings up another point. Quartz was mentioned previously as the converter flux, though, of course, it would not be considered while there was an ore such as No. 1 available, so that the use of a large amount of this ore in the converter is another variation of the problem, which introduces the consideration of just how far it pays to use the converter as a smelting appliance. The principal debit against the operation is the cost of power; the credit is the eliminated

cost of blast-furnace smelting to matte. It may be mentioned here that the amount of silica in the converter slag is dependent, to a certain extent, on this question. If only barren flux is available, the silica in the slag would be kept as low as possible; whereas, when using an ore yielding a profit on treatment, the silica would be run higher, as it would be desirable to smelt a considerable amount of this ore in the converter. To produce more of No. 1 ore, the mine would have to be called upon to rearrange its work. Again, if No. 2 ore can be cheaply mined, it would be advisable to consider the sintering of a larger quantity in order to get more iron for the slag, thus reducing the amount of lime-rock required. These and other permutations must be considered as far as possible before commencing operations, though there are some which cannot be properly calculated until cost data are available. In all cases the process must be definitely mapped out in order to get the information required for the design of the various appliances. Some examples will now be given to illustrate this.

SIZE OF FURNACE. For a charge of this nature, the width of the furnace should be about 52 inches. The furnace should have straight sides that slope outward from the tuyeres to the feed-floor at the rate of about $\frac{3}{4}$ in. per foot. The height from the tuyeres to the top of the jackets should be about 13 ft. Since there are no refractory elements in the ores, a duty of 6 tons per square foot of hearth-area per day may be taken in calculating the furnace-capacity required to treat 1546 tons of charge per day. At this rate, 258 sq. ft. of hearth-area must be provided. Since the width of the furnace is 4.33 ft., the length must be 59.6 ft., which would suggest two furnaces each 30 ft. long, or three of 20 ft. The advantage of a long furnace has been demonstrated at Anaconda,¹⁷ but a single furnace 60 ft. long could scarcely be recommended in the present case. The weak point of a single-furnace plant is that if an accident happens, the blast-furnace department suffers a complete shut-down. In a two-furnace plant, the stoppage of one furnace means a 50% shut-down only. This line of reasoning must not be taken as favoring a multiplicity of units; judgment must be used in deciding what would be best under the circumstances. Two 30-ft. furnaces would be a good arrangement, were it not for the fact that there would be then no allowance for time lost in repairs, or otherwise; the two furnaces would have to be in blast 100% of the time to treat the required tonnage. Mention has already been made of the necessity of allowing some leeway in this respect; also, it is natural to expect that the tonnage to be smelted will increase as the mine develops. So that it would be safe to add 10% to the amount of furnace capacity, and provide 66 ft. of furnace, dividing it into three units each 22 ft. long. Sufficient blast-furnace plant has now been provided to treat 1715 tons of charge per day, which means that, over a given period, two furnaces will run continuously and the third furnace will run 70% of the time. It has been my experience that a certain amount

of extra furnace-capacity can always be used. General managers have a habit of producing some extra tonnage from somewhere, so that a 'stand-by' furnace soon becomes a 'regular' furnace, and the unfortunate furnace-superintendent has to get his repairs done as best he can. It will be noticed that no extra capacity has been provided for the treatment of the flue-dust that will come back to the blast-furnaces after being sintered. Allowance must be made for it at the sintering-plant, but it is already taken care of at the blast-furnaces by our having considered the 'gross' charge as 'net' charge. We have assumed that the furnaces will treat the total charge fed to them, whereas they will smelt actually the gross charge less the flue-dust produced. The small amount of flue-dust from the converters would be treated in the same department, for which reason it is good practice to have a separate flue for the converters, so that the rich flue-dust can be kept to itself and cleaned-up before the end of each month.

CONVERTERS. One Pierce-Smith converter of the barrel type, 10 ft. diameter by 26 ft. long, would be capable of treating the daily production of 138 tons of matte. This statement applies to a new vessel; after being in operation for some time the capacity will be less, as the vessel will become more or less crusted and filled. To ensure steady output and prevent loss of time during repairs, two such vessels should be provided. Proper arrangement should be made for getting the flux into the converters, either by silica-guns or by pipes discharging into the mouths. Provision must be made for drying the flux going to the converters, as wet material is liable to cause unpleasant explosions. Since the converter slag is to be returned to the blast-furnaces, there must be provided suitable appliances for casting, breaking, and loading 105 tons per day. The capacity of the cranes is estimated from the data already obtained. Assuming that the furnaces and converters will be in the same building, it will be necessary to move 138 tons of matte from the settlers to the converters, and 105 tons of slag from the converters to the casting department. Since the introduction of the basic converter the size of cranes has been diminished, as there are no heavy vessels to move for re-lining. The required lifting-power of the main hoist will depend largely on the size of the ladles and boats in use on the converter-floor; the auxiliary hooks are used for light lifts and for dumping. No general figures will be given for the lifting-capacity, as each case must be decided in conjunction with the other details of the process. Besides moving matte and slag, there is always other work for the crane, such as moving boats of scrap and clean-up material, or, perhaps, handling flux and loading converter slag into cars. Once the details of the process have been worked out, the number and length of the trips to be made can be estimated. By using the speeds of travel and hoist (as supplied by the makers), it can be calculated whether the work, as laid out, is within the capacity of a single crane, and if not, how many cranes will be required. Allowance should be made for oiling and repairs, if the

¹⁷L. S. Austin, Trans. A. I. M. E., July 1906.

crane is to be properly maintained, as a break-down may prove costly through interfering with the regular output. For this reason an extra crane is often a good investment. D. C. is preferable to A. C. for crane-power.

SINTERING-PLANT. One Dwight-Lloyd standard straight-line machine, 42 in. by 264 in., should have a capacity of from 80 to 90 tons of this charge per day. There are 130 tons of fine ore to be treated, with an average sulphur content of 18%. Blast-furnace flue-dust is also to be sintered, but, as the ore is all screened, the production of dust should be small. Two sintering-machines, therefore, should be provided, and the sintering-plant laid out so that more machines may be added in case modification in the process of treatment demands it. Bins and a proper belt-conveyor equipment for making suitable mixtures are part of every modern sintering-plant. The machines should be placed high enough to allow for the screening-out and recovery of the resulting fine for re-treatment.

BLOWERS. The amount of air required for the blast-furnaces may be calculated approximately, as follows: The oxygen of the air is used to oxidize the sulphur, carbon, iron, manganese, zinc, lead, and other oxidizable elements, as shown on the charge-sheet. Referring to this, we find that there are 142 tons of sulphur volatilized or (mostly) burned, 155 tons of coke, at, say, 85% fixed carbon or 132 tons of fixed carbon consumed, and 308 tons of iron oxidized to FeO for slagging.¹⁸

Sulphur	142 tons; S	- O ₂ = SO ₂	$\frac{142 \times 32}{32}$	= 142 tons oxygen required
Carbon	132 "	C + O ₂ = CO ₂	$\frac{132 \times 32}{12}$	= 352 " " "
Iron	308 "	Fe + O = FeO	$\frac{308 \times 16}{56}$	= 88 " " "
Total				582
582 tons oxygen ÷ 23% = 2531 tons of air required per 24 hours				
				= 1,757 " " " " minute
$\frac{1,757 \times 2,000}{0.0807}$ = 43,540 cu. ft. of air per minute for 1546 tons of charge				

For more exact calculation, corrections should be made for temperature and pressure.¹⁹ This is necessary if the smelter is situated at any considerable altitude above sea-level. Allowance should also be made for the sulphur that passes off as elemental sulphur; all the sulphur has been considered here as combining with oxygen; actually, the amount would be less, as a certain portion will pass off uncombined, depending on the amount of pyritic minerals in the charge.

Since there is provided a capacity of 1715 tons of charge per day, the above amount of air must be increased to 48,310 cu. ft. But the air-efficiency may be expected to be about 66.6% only, so that the total quantity of air will be 72,520 cu. ft. The term 'air-efficiency' must not be confused with 'blower-efficiency'; the former is the ratio of the amount of air doing useful work in the furnace, to the total amount of air blown in; 'blower-efficiency' is the ratio of the air delivered, by the blower, to the quantity of air the machine is rated to deliver by the maker, or, more correctly, the ratio of

delivery to displacement. So that, to run all three furnaces, 72,520 cu. ft. of air per minute must be provided. The specification for the blower would call for this amount of air to be delivered against a pressure of, say, 44 oz., although the average pressure during operation would not reach that figure. This method of calculating the amount of air is not always employed, empirical figures being generally used in estimating the size of the blowers. Such figures as 1100 cu. ft. per minute per linear foot of hearth, and 260 cu. ft. per minute per square foot of hearth, are fairly reliable.²⁰ Applying these figures to the present case we get: 66 linear feet of hearth at 1100 cu. ft. per minute = 72,600 cu. ft.; or, 286 sq. ft. of hearth at 260 cu. ft. per minute = 74,360 cubic feet.

For immediate requirements, two turbo-blowers, each with a capacity of 36,000 cu. ft. per minute, might be recommended, but the actual selection of the machines may be influenced by the prevailing market conditions, the nature of the bids submitted, and the probability of an increased output in the near future.

The air required for the converters may be calculated in a similar manner, using for the calculation the tons of sulphur, of iron, and of other oxidizable elements in the 138 tons of matte and in the ore or flux added. The air-efficiency is higher in the converter than in the blast-furnace (where a certain amount of air is bound to escape uselessly along the jackets), so that from 80% to 90% of the air entering the converter may be assumed to be doing work. This refers to modern basic-lined converters, which have a higher air-efficiency than the old acid-lined vessels. There is one point that must be taken into account in estimating the required size of a blower for converters, namely, that the vessels do not blow all the time. Using the daily tonnages of matte and flux, and calculating as shown above, there will result the quantity of air necessary for 24 hours of operation. Actually, a converter does not blow 24 hours per day, as time is lost in charging, skimming, and pouring copper, these delays being part of the process and inevitable. Further delays may occur for repairs to the lining or turning-gear, so that a period of from 16 to 20 hours per day, according to conditions, is all that it is safe to take as representing the blowing-time. That is to say, the 24-hour production of matte must be treated in, say, 16 hours; hence the calculated amount of air to be delivered must be increased proportionately.

SUNDRY APPLIANCES. Two examples only will be given under this heading, namely, charge-cars and slag-pots. There are several methods of charging a furnace,²¹ but we will assume that charge-cars dumping by compressed air have been selected for the work. Under the present conditions a charge should form in the furnace a layer from 18 inches to two feet thick. Assuming a column of charge 10 ft. high, the width of the furnace at the surface of the charge will be 5 ft. 7 in. (jackets

¹⁸Richards, 'Metallurgical Calculations'; Part III, chap. 1.

¹⁹Kent, 'Mechanical Engineers' Pocket Book'; p. 581.

²⁰C. C. Christensen, 'Designing Small Copper Smelters'; 'E. & M. J.', Jan. 30, 1915.

²¹Hofman, 'Metallurgy of Copper'; p. 166.

sloping at $\frac{3}{4}$ in. per foot), and the area will be 122.8 sq. ft. One hundred and fifty pounds of charge per square foot of area is a good average figure to use, so that the weight of the charge will be $122.8 \times 150 = 18,420$ lb. Allowance must be made for coke and for extra slag, or for the use of a larger charge, so that the 18,420 may well be increased to 22,000 for the purpose of estimating the size of the charge-car. As the side of the furnace will be closed by four doors, a charge will be divided among four cars each containing 5500 lb., which, at an average of, say, 24 cu. ft. per ton, will require a volume of 66 cu. ft. If desired, the approximate weight per cubic foot of charge may be calculated by using figures given for the cubic feet in a ton of broken ore, not ore in place.²² To the figures given in the reference just quoted may be added some that were determined under actual conditions in a charge-car:

	Pounds per cu. ft. in charge car
Heavy pyritic ore in gabbro.....	149
Gabbro.....	110
Converter slag (30% SiO ₂).....	130
Coke.....	30

The size to which a commodity is broken will regulate its weight per cubic foot, since the finer it is crushed the less will be the interstitial space. For this reason, differences may be noted in tables of such figures by different authorities. Assuming the charge to measure 24 cu. ft. to the ton, we find that, at the top of a 10-ft. column in the furnace, a charge of 20,000 lb. will form a layer about two feet thick, while one of 17,000 lb. will measure about 20 in. thick. The size of charge that will give the best results in the furnace will be determined, of course, by actual experiment after the plant is in operation. Running three furnaces, there will be required two trains of 12 cars each, or 24 cars. As these cars will be working continuously during the greater part of each month, at least four extra cars should be provided to allow for repairs and the renewal of worn-out parts.

Of the two methods of slag-disposal, granulation and haulage, we will assume that the latter has been selected. From the charge-sheet we find that the production of slag will be 72.6% of the charge, or 1245 tons when smelting 1715 tons of charge in three furnaces, which gives an hourly production of about 52 tons of slag. The adoption of a few pots of a capacity of about 20 tons each is to be preferred to that of a long string of small pots, so that the flow of slag may be taken at three pots per hour. The number of pots required would work out something like this:

	Slag-pots
At furnaces.....	3
At dump or returning to furnaces.....	3
Spare, in case of repair or accident.....	2
Total to commence operation.....	8

As the dump grows, the haul will be longer, although the time-factor is well taken care of by the large pot. If haulage is by electric motor, the pots should be arranged to dump by the same power. It is convenient to have one pot that dumps over the end of the track, to facili-

tate the extension of the track along the line of its direction. A good pot of this type is the Dewhurst, as used in some plants in Australia. To calculate the required volume of a pot for the slag under consideration here, the specific gravity of the slag may be taken at 3.5.

STORAGE-BINS. These are necessary to protect the furnaces against irregularities in the receipt of ore, flux, or fuel. The amount of storage provided depends on the distance from the source of supply, and the probability of interruption or variation in the supply. In a plant where the furnace-charge is bedded, the number of bins will be small, as the majority of the materials will go direct to the beds. Under ordinary circumstances it is usual to provide bins to hold a supply sufficient for three or four days, but this should be increased if there is any serious danger of interruption to the delivery of materials. The farther the plant is from the mine, the lime-quarry, and the coke-ovens, the more liability there is for interruption in the regular transportation. Since the running of furnaces on reduced blast while waiting for materials is not conducive to large dividends, the amount of storage to be provided, both in bins and in stock-piles, is a matter that must be considered carefully. In case of a strike at the mine or a wash-out on the railroad, large stock-piles are comforting things to have in the smelter-yard, provided means are at hand to reclaim them, but there is a limit to the amount of money that it is advisable to tie up in this manner. Local conditions will affect policy in this regard, although it may be said, in general, that there is usually a liberal allowance made in the case of fuel, so that a good stock of coke is provided.

The storage-bins from which the charge-cars are loaded should be conveniently near to the furnaces. The chutes should be spaced to coincide with the centres of the charge-cars when a train is spotted for loading. While there is something to be said for each of the various types of bin, the flat-bottomed bin with a side-discharge is hard to beat. The trouble with a bottom-dump bin is generally with the gate. Putting a sloping bottom in a side-discharge bin reduces its capacity considerably, and the sloping bottom requires extra support; also, it must have protection from the falling material during filling. The flat-bottomed bin with side-discharge will always have a layer of material to protect the bottom; it will discharge well and generally have some material left in it that can be drawn upon in an emergency by putting shovels to work. Charges are usually weighed by weighing-hoppers or by track-scales; in the former case more head-room is required. In calculating the capacity and number of bins required, the weight per cubic foot of broken or loose material must be used. Since coke is frequently loaded directly from railroad-cars into the coke-buggies, the supply of coke in the storage-bins may not be drawn on very often, but it is a good precaution to have it there. Under ordinary circumstances, in the present case, a sufficient number of bins would be provided to hold the following tonnages:

	Tons
Coke.....	600
Lime-rock.....	1,800

²²Liddell, op. cit., p. 175.

	Tons
Ore No. 1	1,400
Ore No. 2	2,000
Sinter	600
Converter slag	400
Converter flux	250
Fine ore stored at sintering plant bins	600

CONCLUSION. It is apparent, of course, that before commencing any estimate or design, it is necessary to have as complete a set of data as is possible on all the phases of the problem. Included in these, and of especial importance, are the local conditions, such as the cost of labor and of supplies, the magnitude of the operations (both proposed and probable), and other factors of like nature mentioned previously in this article. The more accurate and complete the data, the more correct should be the estimate, although it must be admitted that to forecast accurately every detail of a process is extremely difficult, if not impossible. A flow-sheet is of assistance in revealing incongruities, or in calling attention to omissions, in the process, and should be drawn up as soon as the general outline of any proposed set of operations has been determined. It should show not only the path followed by all the materials, but also the figures of tonnage and analyses (calculated or assumed) included with every item. These graphic representations are useful in comparing two or more different schemes. In some cases where sufficient data are unobtainable, recourse must be had to the performance of a neighboring plant, or to a comparison with a similar enterprise elsewhere, making allowances (plus or minus) for local differences, in doing which experience and judgment are of the greatest value. Assumptions sometimes must be made in order to get an outline of the work, but the experienced engineer is always careful of his premises, as he knows full well that upon his judgment in such matters hang all the law and the profits.

MINING OF ANTIMONY ores in the United States practically ceased in 1918. The amount produced in that year was only 190 tons of ore with a content of 50 tons of antimony, as compared with 1600 tons of ore in 1917 and 5000 tons in 1915. About 2500 tons of metallic antimony was produced by smelters in the United States in 1918, almost entirely from foreign ores. The imports were large, amounting to 2734 tons of 50% ore, and 13,374 tons of metal. Mexico and Bolivia provided most of the ore imported; the metal came chiefly from China. According to a statement made public by the U. S. Geological Survey, the greatest demand for antimony is for war purposes, chiefly in the manufacture of shrapnel bullets. The peace-time consumption of the metal amounts to only a small proportion of its war-time consumption. Antimony oxides are used in making glass, enamel, and paint; the sulphides in making rubber; and the metal in certain alloys, such as type metal, babbitt, Britannia metal, and hard lead. The great importance of antimony as a war metal is shown by the total world's production in recent years. In normal pre-war years this amounted to about 20,000 metric tons per year. In 1916, however, the estimated world's production was 78,700 tons. This large output exceeded even the war demand, and in 1917

the production had fallen to 54,300 tons. More than half the world's supply comes from southern China, principally from the Province of Hunan. France in 1913 produced about a quarter of the world's supply, and during the War large deposits were developed in Algeria. Mexico is the next in importance and in 1913 contributed over one-tenth of the world's supply. Bolivian deposits were extensively developed during the War. The U. S. Geological Survey's annual report on antimony, by Henry G. Ferguson, has just been issued.

POTASH to meet the industrial requirements of the United States, was formerly imported almost entirely from Germany. Purely from a standpoint of nationalism it is to be hoped that the United States will some day be able to throw off the German yoke. But high-priced potash increases the expense of producing crops, which in turn bears upon the cost of living. Thus it is a debatable question whether the infant potash industry is entitled to receive the tariff protection it requires, at the expense of a further rise in the cost of living. Dr. H. J. Wheeler, fertilizer expert of the American Agricultural Chemical Co., recently said that the United States has many undeveloped possibilities of a future potash supply fully adequate for our national needs, but no one of these offers hope of furnishing any considerable amount at prices which will permit of serious competition with German muriate of potash (containing 50% of potash), which can be landed in this country at \$12 to \$15 per ton and still yield a living profit to the producers. Prior to the War the United States was importing from Germany for agricultural purposes about 226,000 tons of actual potash in the form of German potash salts, which was equivalent to about 452,000 tons of muriate of potash. While there is sharp divergence of opinion among authorities as to the actual need for potash in agriculture, it is significant to note that a careful estimate by States places the minimum requirements of the entire country for agricultural purposes at 147,243 tons per year of actual potash (potassium oxide), equivalent to 294,486 tons of muriate of potash, or about 736,215 tons of the crude potash salts now being produced from the Nebraska lakes. In other words, the incompressible minimum requirement is very much more than half the annual consumption for such purposes prior to the War. As against this minimum requirement and annual importations of 226,000 tons of actual potash before the War, there was produced in the United States in 1917, the equivalent of but around 60,000 tons of muriate of potash. In the year 1918 the output was perhaps 120,000 tons, equivalent to about 60,000 tons actual potash. The current year will show a further increase, but this will be considerably short of amount required. Thus, from the standpoint of both volume and economy of production, the American potash producer remains at a very decided disadvantage as compared with his German competitor, and the conclusion is obvious that emancipation of the American farmer from German potash domination has not yet come.

Statistical Review

Production of Base Metals for 1919*

Copper

The production of copper in the United States in 1919 was markedly smaller than in 1918, according to preliminary figures and estimates collected by B. S. Butler, from all plants that make blister-copper for domestic ores, or that produce refined copper. At an average price of about 19 cents per pound, the output for 1919 had a value of \$243,000,000, as against \$471,000,000 for 1918.

The figures showing the smelter production from domestic ores represent the actual output of most of the companies for the first 11 months of the year and the estimated output for December. A few companies gave no figures for November, but furnished estimates of the combined output of November and December. The production of blister and Lake copper from domestic ores was 1,278,000,000 lb. in 1919, against 1,908,000,000 lb. in 1918 and 1,224,000,000 lb. in 1913.

The supply of refined copper (electrolytic, Lake, casting, and pig) from primary sources, domestic and foreign, for 1919, is estimated at 1,800,000,000 lb., compared with 2,432,000,000 lb. for 1918 and 1,615,000,000 lb. for 1913.

According to the Bureau of Foreign and Domestic Commerce, the imports of copper in all forms for the first 10 months of 1919 amounted to 346,855,000 lb., against 575,800,000 lb. for the 12 months of 1918.

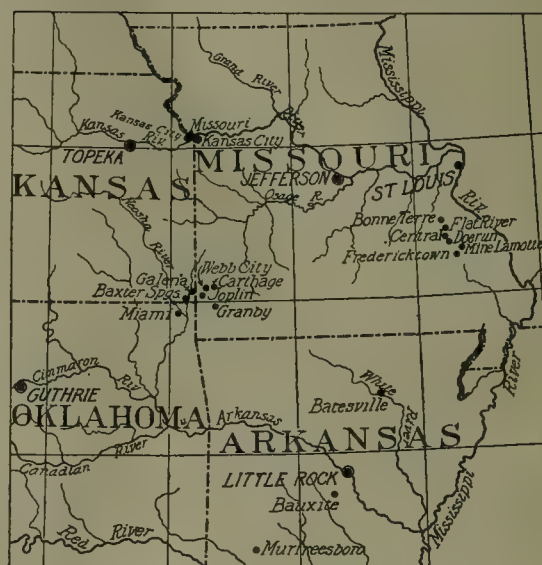
The exports of pigs, ingots, bars, plates, sheets, rods, wire, and like copper products for the first 11 months of 1919, as determined by the same bureau, amounted to 496,350,000 lb.; the exports for the 12 months of 1918 were 744,429,000 pounds.

At the beginning of 1919 about 180,000,000 lb. of refined copper was in stock in the United States. Adding this quantity to the refinery output for the year shows that the total available supply of refined copper was about 1,980,000,000 lb. On subtracting from this total the exports for the first 11 months and the estimated exports for the last month, and assuming that there was no change in stocks, it appears that the supply available for domestic consumption in 1919 was considerably less than the 1,661,000,000 lb. available in 1918.

Lead and Zinc

MINE PRODUCTION. The mine output of lead and zinc in the United States declined greatly in 1919, following a sharp decline in 1918, according to a statement compiled by C. E. Siebenthal from reports and estimates by producers and from the records of the Bureau of Foreign and Domestic Commerce.

The output of 'soft' lead by mines of the Mississippi Valley and Eastern States was 217,000 short tons, and that of argentiferous lead by mines of the Western States was 208,000 tons, a total of 425,000 tons, compared to 267,184 tons and 314,470 tons, respectively, a total of 581,654 tons, in 1918, and to 273,095 tons and 377,854 tons, respectively, a total of 650,949 tons, in 1917, a decrease of over 156,000 tons in 1919, compared with a decrease of 69,295 tons in 1918. The south-eastern Missouri district made the largest production, 153,500 tons, and the Coeur d'Alene district of Idaho was next, with



THE MISSISSIPPI VALLEY LEAD AND ZINC FIELD

86,000 tons. The imports of lead in ore and bullion were about 63,000 tons, as compared with 93,367 tons in 1918.

The recoverable zinc content of ore mined in 1919 was about 569,000 tons, compared with 632,243 tons in 1918 and 713,359 tons in 1917. The output of the Eastern States was 116,500 tons, that of the Central States was 318,000 tons, and that of the Western States was 134,500 tons, compared with 124,268 tons, 302,662 tons, and 195,313 tons, in 1918. The output of the Central States gained slightly over 1918, by an increase of about 20,000 tons in the Joplin district. The gain in this district was a result of an increase in the output of Oklahoma, which reached a total of over 189,000 tons, the largest zinc output ever made by any State. Oklahoma produced 161,401 tons in 1917 and Missouri produced 155,960 tons in 1916. In 1919 Montana apparently produced over 88,000 tons and New Jersey over 87,000 tons of zinc.

The imports of zinc in ore fell off from 24,809 tons in

*From preliminary reports of the U. S. Geological Survey.

1918 to 17,000 tons in 1919. The zinc content of ore imported from Mexico dropped from 18,426 tons in 1918 to 11,000 tons in 1919.

REFINED LEAD. The production of primary domestic desilvered lead in 1919 was 218,500 short tons, of soft lead 151,000 tons, and of desilvered soft lead 61,500 tons, making a total output from domestic ores of 431,000 tons of refined lead, compared with 539,905 tons in 1918, made up of 282,024 tons of desilvered lead, 210,463 tons of soft lead, and 47,418 tons of desilvered soft lead. The output of lead smelted and refined from foreign ore and bullion was 62,000 tons, compared with 100,290 tons in 1918. The total lead smelted or refined in the United States was thus 493,000 tons, compared with 640,195 tons in 1918. The production of antimonial lead was 10,000 tons, against 18,570 tons in 1918. The exports of lead of foreign origin were 44,000 tons and of lead of domestic origin 14,000 tons, compared with 40,480 tons and 64,194 tons, respectively, in 1918, a decline of nearly one-half in the total exports. The quantity of lead available for consumption in this country was 456,000 tons in 1919, compared with 493,625 tons in 1918. In comparing the quantity available for domestic consumption in 1919 with that available in 1917 and 1918, it should be noted that considerable quantities were shipped abroad in those years for the use of the American Expeditionary Force, which, not being recorded as exports, are included in the apparent consumption.

The average price of lead at New York in 1919 was 5.8c. per pound, compared with an average price of 7.1c. in 1918. At the beginning of 1919 lead was quoted at 5.75c., but it went slightly below 5c. in April and May, after which it steadily climbed until the close of the year, when it was quoted at about 7.5c. This advance in price, despite the falling off of exports and the cessation of shipments to the American forces abroad, would seem to indicate that the production has been nicely adjusted to the needs of the domestic building program.

The Flint Mill & Furnace Co. built a 20-ton Fink furnace at Wauwatosa, Wisconsin, in 1919 to treat Wisconsin lead concentrate. The Mineral Point Zinc Co., at Depue, Illinois, operated a lead blast-furnace upon valuable lead-bearing zinc-retort residues. The U. S. Smelting, Refining & Mining Co. acquired the electrolytic lead refinery at Grasselli, Indiana, from the U. S. Metals Refining Co., near the close of the year. Many lead smelters were closed for longer or shorter periods during the year or ran at partial capacity. The Globe plant of the American Smelting & Refining Co., at Denver, Colorado, was permanently closed early in the year.

ZINC. The production of primary metallic zinc from domestic ores in 1919 was 446,000 tons, and from foreign ores 13,000 tons, a total of 459,000 tons, compared with 492,405 tons and 25,522 tons, respectively, a total of 517,927 tons, in 1918. Of the output of domestic zinc in 1919 nearly 27,000 tons consisted of electrolytic zinc, as compared with 38,916 tons in 1918. In addition there was an output of over 17,000 tons of re-distilled secondary zinc compared with 9597 tons in 1918, making a total

supply of distilled zinc in 1919 of 476,000 tons, of which about 45,000 tons was of high grade, 24,500 tons of intermediate grade, 77,500 tons was select and brass special, and 329,000 was prime western. The production of the corresponding grades in 1918 was 129,023 tons, 68,937 tons, 98,584 tons, and 230,930 tons, respectively. Of the total output of primary zinc in 1919, about 118,000 tons was made in Illinois, as against 141,844 tons in 1918; 43,000 tons in Kansas as against 29,149 tons; 119,000 in Oklahoma as against 139,066 tons; and 65,500 tons in Pennsylvania as against 77,342 tons in 1918.

The exports of zinc made from foreign ores were 17,500 tons and those of zinc from domestic ores were 127,000 tons, compared with exports of 26,837 tons of foreign and 80,244 tons of domestic zinc in 1918. The exports of domestic zinc include 20,000 tons of sheet zinc as against 13,875 tons in 1918. The stock of zinc at smelters and in warehouses at the end of November was 51,500 tons as against 59,651 tons on June 30, 1919 and 41,241 tons at the close of 1918. The apparent consumption of primary zinc during 1919 was 304,000 tons, compared with 423,361 tons in 1918 and 413,643 in 1917, a quantity somewhat below the pre-war figure, which for the years 1910-1913 averaged 327,255 tons.

The average quotation for prime western zinc at St. Louis in 1919 was 7c. per pound, compared with 8c. in 1918. The price of prime western zinc began the year 1919 at 7.7c. in the St. Louis market, declined below 6c. in May, rose to nearly 8c. at the end of July, dropped back nearly to 7c. late in September, and then improved to the end of the year, closing at about 8.7 cents.

The decrease in smelter stocks since June 30, coupled with the practical absorption of the large Government stocks held by the Ordnance Bureau at the beginning of the year, taken with the continuance of large exports and the growing demands of the domestic building industry, caused the stiffening of prices and the increase in operating capacity during the last quarter of 1919. The exports of zinc averaged over 11,500 tons monthly. Great Britain made the largest demand for our exports of slab zinc, taking the greater part of them doubtless in rebuilding her export trade in galvanized products, and France, Japan, and Italy were next in order. Italy was the largest importer of sheet zinc from the United States in 1919, Great Britain was a close second.

The 'Metal Bulletin' of London, under date of December 16, 1919, calls attention to the critical state of the British zinc-smelting industry, and, considering the possibility of obtaining zinc from other countries, points out that Germany, on account of lack of fuel and ore, is producing only about 3000 tons per month, no more than her own needs; that Belgium, producing now about 3000 tons per month, will need the whole of her output in 1920 for sheet zinc; that France, on account of the destruction of her works and lack of coal, cannot be counted on for supplies in 1920; and that works in Holland are closed because of the prohibitive price of coal. The inference is that the United States will continue to export zinc to England at least for a year.

The Blue Sky Law

Senator Kenyon has introduced a bill, S. 3702, for the purpose of giving some protection to persons having a limited capital to invest, who have frequently been victimized by dishonest and unscrupulous salesmen of worthless or questionable stocks. The text of the bill is as follows:

To regulate the issuance of stock by corporations engaged in interstate commerce.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That whenever an offering is made to the public of an original issue security by any corporation engaged in interstate commerce the issuing company shall file with the United States Postmaster at its legal address for public inspection, and also with the Federal Trade Commission at Washington, a statement signed by its responsible officers or promoters showing—

(a) The purpose for which the corporation is organized;

(b) The officers and directors or promoters, and their residences and whether securities are held by a holding company or whether it holds securities of another corporation, naming such corporation; what commission, if any, the officers, directors, promoters, or agents are to have for the organization of said corporation and the floating of said securities;

(c) The latest balance sheet of the issuing corporation; such statement shall show in detail all payments for tangible and intangible property, good will, promotion fees and any and all other agreements for the disbursement of money except as shown in (d) hereinafter;

(d) The purposes to which the proceeds of the sale of the new security are to be devoted;

(e) The terms of the flotation showing the price at which the securities are sold by the issuing corporation; the estimated expense of the flotation; the name of underwriters, if any, and the terms of underwriting and the names of and terms by which sub-underwriters, syndicates, bankers, brokers and others deal in the original sale of such securities.

Sec. 2. That the statement provided for in section 1 shall be a public record; that any prepared, prospective circular offering such securities for sale must contain the information described in sub-divisions (a), (b), (c), (d), and (e) of section 1; and that a copy showing the same must be attached to each bond, certificate of preferred or common stock and to each receipt or certificate evidencing a subscription to such security. Any false or mis-leading statement in such statement herein referred to shall constitute perjury as to each and every person issuing or signing the same. It shall be the duty of the United States district attorney of the district in which such person or persons may be found to reside to proceed against any person so committing perjury under the terms of this Act.

Sec. 3. That any purchaser who may purchase such original issue of security where material mis-statement is

made in the statement provided for under section 1 of this Act may recover twice the amount of all moneys paid for such original security and may join the issuing company and each of its officers, directors, and promoters as well as the underwriting syndicate, and each and every other party to the sale of such security; and judgment shall be rendered jointly and severally against each one thereof if and when material mis-statement is established; provided: That suit must be brought within one year after the purchaser shall have knowledge of such material mis-statement.

Sec. 4. That any person who shall mail or cause to be mailed in any post office of the United States any original issue security, knowing that the statement required by this section has not been filed as prescribed herein; or who shall mail or cause to be mailed in any post office of the United States any statement required by this section knowing the same to be false in any particular, shall be fined not less than \$5,000, or imprisoned not more than five years, or both such fine and imprisonment.

THE PLATINUM MARKET during the first quarter of 1919 was easier than in 1918, owing to the facts that the governmental restrictions on the use of platinum had been removed and that the Government was disposing of its surplus stocks. The low price of \$99 per ounce was reached late in March and was maintained about a month, but the price gradually stiffened until August, when the Government stocks were exhausted, and then abruptly rose to \$110 per ounce. Since the middle of August the price has continued to advance about \$5 each month, the demand for the metal has been strong and the supply short. During the first nine months of 1919 about 40,400 oz. of platinum was imported, and importation at this rate will probably be continued during the rest of the year, so that, if the normal domestic production of 7000 to 10,000 oz. is maintained, about 54,800 oz. of new platinum should be available, aside from the stocks of platinum, about 65,000 oz., held at the beginning of 1919. So far as known there has been little change in the domestic mining of platinum. The wide search made in 1918 for domestic sources of platinum has apparently yielded little results. Colombia may supply more crude platinum in 1920 than in the past, but its producing capacity is limited by the methods employed in washing the gravels from which the metal is obtained. Practically no supplies can be expected from Russia for several years. The osmiridium field of Tasmania appears to need only higher prices to stimulate larger production, but even with this stimulus it can probably produce not much more than 2000 oz. per year. According to James M. Hill, of the U. S. Geological Survey, there seems to be little hope of any marked increase in the output of platinum in the United States or Canada over the small output heretofore made, and as the supplies are below normal and the demand is large it is reasonably certain that the price of platinum metals in this country during 1920 will be at least as high as it was during the last quarter of 1919, and possibly higher.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA

TRANSPORTATION PLANNED FOR SALMON RIVER DISTRICT.

HYDER.—According to reports from Seattle, Governor Riggs of Alaska has left for the Eastern States with a view to interesting Government authorities in the question of supplying more adequate transportation facilities for Hyder. He is quoted as expressing confidence in the future of the Salmon River district to which general attention and interest has been attracted by the Premier mine. The Alaska Territorial Government, co-operating

ARIZONA

'SAFETY-FIRST' REWARDS FOR C. & A. EMPLOYEES.

DOUGLAS.—Little change was evident at the local smelters during the month, both the Copper Queen and Calumet & Arizona plants maintaining the scale of operations fixed two months ago. Three representatives of United Verde company were visitors at both smelters during the last week of January, in order to study the ore-crushing practice. From here they went to El Paso on a similar mission. This was preliminary to making final recom-



MIAMI, ARIZONA. MIAMI NO. 4. SHAFT IN BACKGROUND. POWER-PLANT AT EXTREME RIGHT

with the Forestry Service and the Alaska Road Commission, is to have a road completed up Salmon river, across American territory to the British Columbia border by next summer. It is well to mention here that the British Columbia government has expended a considerable sum in the construction of a road from Stewart to Hyder and in the building of a road from the American boundary to the mines. More expenditure, it is likely, will be authorized this year for the further improvement of means of transportation on the Canadian side. Governor Riggs is credited with saying that this American road will permit silver ore being brought to Hyder for transportation to the smelters. He also is said to be dissatisfied because the American steamship lines do not touch at Hyder while the vessels of the Grand Trunk Pacific Steamship Co. do so at regular intervals.

mendations upon the type of crusher to be adopted by the United Verde in its new 2500-ton plant which soon is to be erected. The Clark officials were C. M. Hoffman, superintendent of machinery; Thomas Taylor, superintendent of the smelter; and Charles Kuzell, assistant superintendent of the smelter.

BISBEE.—The annual safety-first meeting of the C. & A. company brought forth announcement that 16 of the company's 28 shift-bosses had made perfect records, each having worked the men under him 2500 shifts without a single man being laid off for injury. Each man received a substantial prize. Since inauguration of the safety movement in 1914 there has been a decrease of 57% in number of accidents. It is hoped to make 1920 the banner year in this respect. The men receiving prizes were R. B. Linden, J. F. Ward, George Graham, P. V. Banks,

Ted Dunlap, Tom Mason, J. C. Lackner, William Sharp, Norman McKenzie, and M. E. Kaum, of the Briggs mine; J. R. Wester, N. J. Cosgrove, John Saunders, W. D. Harrington, Tom Fuller, Jacob Erickson, M. K. McCrea, and George Matzell, all of the Junction mine.

TUCSON.—J. H. Huntsman, president of the Gold Prince Mining Co., has denied that his company has offered \$500,000 for the purchase of the Dos Cabezas Gold Ridge mine as stated recently at Wilcox by H. C. Kimball. The Gold Prince has been negotiating for the purchase of the Dos Cabezas mine but no definite offer for it has been made. The matter was brought up at a meeting of stockholders held in Wilcox, early in January, and committees were named representing both companies to investigate and report upon the proposed sale or merger of the two properties, which adjoin in the Dos Cabezas district of Cochise county. A definite proposition will be made when a second joint meeting of stockholders is held at Wilcox on March 4. The stock of both companies is held mainly by Arizonans. Favorable report has been received here relative to flotation-concentration tests made upon ore from the Daily-Arizona Consolidated Copper Co., operating in the Catalinas near here. Recovery of 93% of the copper was obtained from ores containing an average of 6% copper, besides gold, silver, and zinc. A body of 70,000 tons of ore averaging 3% copper and \$2 gold and silver, has been developed. Following construction of a road from Oracle to the mine, it is anticipated that a mill will be built.

COLORADO

MINING MEN CONVENE AT DENVER.

DENVER.—The Colorado chapter of the American Mining Congress and the Colorado Metal Mining Association recently concluded their customary annual convention. The sessions continued three days and were held in the Senate Chamber of the Capitol. They were attended by many of the State's representative mining men such as George M. Taylor, Bulkeley Wells, George E. Collins, Charles A. Chase, R. M. Henderson, and Jesse F. McDonald, all of whom participated actively in the proceedings and discussions. Every mining county was well represented by delegates. Numerous papers were read upon such subjects as mine taxation, industrial insurance, complex-ore problems, and the development of the oil-shale industry.

A number of resolutions, after passing through a committee, were passed by the convention. One such resolution provided for the holding of a mining exposition in Denver's municipal auditorium during the coming summer. In the discussion of this resolution the idea was elaborated until, if the exposition be held as suggested, it will be most comprehensive and will include a pioneer placer camp along the bank of the Platte river within the city limits, displays of primitive devices along with up-to-date apparatus in all mining and milling lines, collections of rare and precious ores, a division for oil-shale, and demonstrations in ore-dressing and concentrating by gravity and flotation methods. George M. Taylor, presi-

dent, will appoint a committee to undertake full charge of this project.

One resolution urged investigation by Colorado's congressmen of the alleged extortionate prices charged by explosive manufacturers. An appeal to the U. S. Director General of Railroads and to the State Public Utilities Commission to abrogate a recent flat increase of 25% in freight-rates on ores was the substance of a resolution. Another protests against the proposed increase of 20% in the price of electric power by the Colorado Power Co., and calls upon the Public Utilities Commission to not grant the increase.

It was resolved that the Legislature should appropriate sufficient funds to enable the State Geological Survey to undertake more work in the mining and mineralized regions and that measures should be taken toward greater co-operation between the Federal and State bureaus of mines to the end of securing more investigation into the treatment of low-grade complex ores. The Jones-Reavis Senate Bill 2232, designed to unify all Federal engineering activities into a Department of Public Works, was favorably considered. Vigorous protest was raised against a proposed law being formulated by the county commissioners on the subject of mine taxation. The resolution stated that the passage of such a law would "result in a severe additional handicap to all mining operations and bring about the closing of the majority of the mines now producing."

To anyone familiar with former activities of these two organizations—the American Mining Congress and the Colorado Metal Mining Association—in combatting and denouncing the 'smelter trust' in Colorado, there is a tone of cynicism in one resolution which, after pointing out the sharp decline in the production of gold and silver during recent years and the closing down of two of the largest custom smelters, petitions the American Smelting & Refining Co. to delegate its president to make a visit to Colorado to look over the situation.

MICHIGAN

NO. 3 SHAFT AT THE CHAMPION MINE IS INOPERATIVE.—DEVELOPMENT WORK BY ARCADIAN CONSOLIDATED.

HOUGHTON.—Champion mine of the Copper Range is operating but three shafts. No. 3 shaft was discontinued last October and probably never will resume operations. All of the mineralized territory that was tapped by this shaft may be worked quite as economically from No. 2 and No. 4 shafts and the cost of maintenance of this additional shaft is thus eliminated. The abandonment of No. 3 was at the 21st level, at a depth of 2339 ft. from surface.

Sinking continues at No. 1 and at No. 2 shaft, a total of 200 ft. having been done at No. 1 during 1919, and 220 ft. at No. 2. No sinking was done at No. 4 last year. As a matter of fact, the Champion has more ore occurring in true fissures than the Trimountain or the Ahmeek, where the fissure veins have been a continuous contributor for many years. At this time No. 1 shaft has attained a total depth of 2714 ft., the 25th level; No. 2,

2700 ft., the 24th level; and No. 4 shaft is down 2388 ft., the 22nd level.

R. H. Shields, president of the Arcadian Consolidated, announces the complete success of his Eastern trip, from which he returned to Houghton last week. He has succeeded in attracting strong New York interests to the property and the company is now in a position to go ahead with development work for at least two years without likelihood of an assessment.

New Arcadian could resume operations today if market conditions warranted. As it is, the resumption of the development work probably will be delayed till March 1. Only a force sufficient to keep the water out of the New Arcadian shaft has been maintained. Since the suspension of operations the New Baltic shaft has filled, but as these workings are not extensive the cost of unwatering will be less than would have been the expense of keeping the shaft free from water.

NEVADA

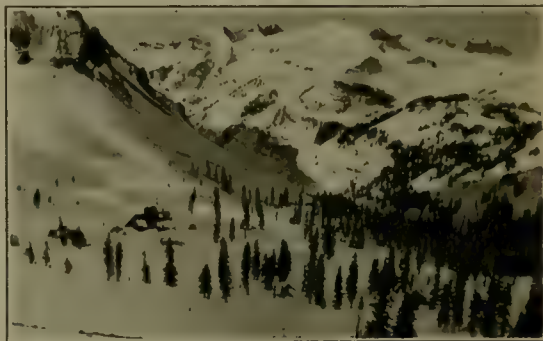
REVIVAL OF ONCE-FAMOUS SILVER MINES.

RENO.—Mining in Nevada, as a result of higher metal prices, is being done on a larger scale and is on a better financial footing than for many years past. In every part of the State where metal has been found, old and new areas are being prospected, while recent discoveries have been made in several localities. A half dozen or more once-famous silver-producing camps show signs of returning vitality. Virginia City, Eureka, Austin, Tuscarora, Candelaria, Marietta, Montezuma, Cortez, and Unionville, all famous a generation or more ago, are again centres of activity. Many outright sales of mines and prospects have been recorded; many properties are being worked on a lease and option basis; and funds are being provided directly for mining. As a result, fewer automobiles are sold to brokers and promoters, but considerably more rock is broken and the powder and machinery salesmen are kept busy. The collapse of the Divide boom has been ascribed in large measure to the action of company promoters, in 'dumping' on the market their promotion stock before the treasures were financed.

At Virginia City the old bonanza properties are taking a new lease on life. Deep levels are being re-opened, virgin areas explored, and burned stopes reclaimed, resulting in a substantial increase in production. Annual reports on the Consolidated Virginia and Ophir mines, by Whitman Symmes, manager, describe mine improvements, new ore-reserves, augmented mill-capacity, and growth in net profits, with liquidation of old indebtedness. A number of the old mines are being worked, for the most part on a limited scale but with prospects of increasing production. Several properties lying in the belt between the Comstock and Brunswick lodes will be developed, actively, with the coming of settled weather conditions. More than 400 miners are said to be employed at present.

Eureka is staging the most pronounced revival among camps of the 'moribund' class. The Ruby Hill Develop-

ment Co., of which Edward O. Holter of New York is president, has acquired from the United States Smelting & Refining Co. a long-term lease, with an option on the control of the Richmond-Eureka property, at one time the largest silver-lead producer in this country. The mine was equipped with high-power pumps and machinery several years ago when operated for a time by the U. S. Smelting Co. Shipment of fluxing ore to that company's smelters in Utah was interrupted by a railroad wash-out, and when the road was re-built a controversy over freight rates resulted in abandonment of the project. A railroad spur is being laid from the Eureka & Palisade narrow-gauge main track to the mine, on Ruby hill. Three deep shafts on the Richmond and Eureka Consolidated groups will be utilized in development work at depth. The Eureka-Croesus owns a group of mines that were notable producers of high-grade ore, with the famous old Dunderberg as the central property. A large amount of work has been done during the past year; rich orebodies have been opened far below the early levels, a valuable asset has been found in quantities of stope-filling that is said to average above \$20 per ton; and avail-



THE CUMBERLAND MINE, NEAR MAYDAY, COLORADO, PARTLY BURIED IN SNOW

able reserves, including the old slag-pile, are appraised at many millions of dollars. Eugene Davis, the manager, has purchased the Eureka & Palisade railroad, and upon the advice of J. H. Mackenzie and George O. Bradley and others, will build a smelter in the spring. Julius Huebner, the superintendent, reports an average silver-lead content of \$23 per ton in filling drawn recently from the main Dunderberg stope. Sacked ore assaying \$400 per ton has been shipped lately to Utah smelters. The Eureka-Holly is sinking its main shaft from the 400-ft. point and a winze below that level is in high-grade ore. The richer ore is shipped to the smelter and 60,000 tons of mill-ore is blocked-out above the 400-ft. level. The Eureka-Climax is driving a tunnel to cut the Deadbroke vein below old stopes that produced rich ore. Work will be started on several other properties in the district with the coming of good weather.

At Candelaria the work of the Candelaria Mines Co. has been confined chiefly to the Lucky Hill mine, from which a considerable quantity of ore has been shipped in the past year. The company, now controlled by the In-

ternational Nickel interests, has options on three of the largest early-day producers and owns the Lucky Hill mine. Engineers report several hundred thousand tons of low-grade free-milling ore available on these properties. Charles D. Kaeding, manager, has been inspecting the property. Mr. Kaeding is manager, also, for the Dome Mines Co. and the Rochester Nevada Silver Mines Co. The Candelaria company is now planning the construction of a mill. Marietta, a short distance from Candelaria, was an important producer of silver in the 'seventies. Prospectors lately have found rich croppings, resulting in the location of a number of claims. One or more of the old mines will be re-opened shortly and worked on a substantial scale.

In Humboldt county, which lost most of its active mines when Pershing county was created, the camp of National is still sending out occasional shipments of high-grade ore, but only lessees are working. At Spring City, north of Paradise, an effort has been made to revive the old Bell silver mine, but it is reported that W. C. Ralston and associates have failed to make the payments required under the option. A discovery of some importance is reported at a point near the Adelaide copper property, south of Golconda. Near Imlay, a station on the S. P. railroad, the Majuba Hills company is said to be producing some good ore that contains a number of metals.

UTAH

DEVELOPMENT AT SILVER KING COALITION.—NEW PROPERTIES IN EUREKA DISTRICT.

PARK CITY.—Shipments for the week ending January 24 totalled 2344 tons, as compared with 2198 tons for the previous week; the increase being due to heavier shipments from the Ontario property. Details follow: Ontario, 811 tons; Judge Mining & Smelting, 654 tons; Silver King Coalition, 551 tons; Daly-West, 164 tons; Daly Mining, 110 tons; Naildriver, 155 tons.

The new ore, recently found in the cross-cut from the drift on the 700-ft. level of the Naildriver mine, continues to show consistent improvement, according to J. D. Fisher, superintendent. This vein averages 35 oz. silver and 30% lead, and has been drifted upon eight or ten feet. The cross-cut is being continued to explore the mineralization on the contact, which lies a short distance ahead.

The recent program of development at the Silver King Coalition property has opened a large and hitherto untouched ore-zone, according to W. Mont Ferry, the new managing director. Should expectations be realized, the development work will open up new territory in the ore-bearing formation for a distance of about 3000 ft. on its strike. The orebodies discovered in the Coalition have been found along the fissure system, which embraces the Gold Ledge, Jewel, and other fissures. These stopes were found in lime beddings overlying quartzite along north-east and south-west fissures. Paralleling these fissures to the north-west some large stopes, including what are known as the American and O'Brien stopes, were mined, but a fault was encountered which, for a long time, was

accepted as the end of the ore-zone in the paralleling fissure zone. The lime strata traversed by the two fissure systems were correlated and the faulting system encountered in the O'Brien stope was mapped out, after which development work was undertaken in the M. L. M. drift, a cross-cut tunnel which extends from the main shaft on the 1300-ft. level to the paralleling fissure system. The company is also pushing prospecting work in other parts of its property. In the old stopes and upper levels, it has adopted a leasing plan to clean up the ore which, on account of the excessive cost of supervision, could not be profitably mined on company account.

EUREKA.—The Iron King branch of the East Tintic railroad should be completed about February 10. This property has a large tonnage of iron ore blocked out, which is ideal for fluxing. As soon as the railroad is completed, shipments to valley smelters will begin. The recent surface-find at the Tintic Empire property has been opened up by trenching for a distance of 30 ft. along the vein, and for a depth of 4 or 5 ft. Theo. Nicholes, superintendent, states that recent assays of the ore show 7 oz. silver and 26% lead.

Work of sinking a new double-compartment shaft at the property of the Tintic Delmar company in the northern part of the district, has been started. Although this property was located a number of years ago, no work has been done on an extensive scale. Recently a reorganization was brought about and funds raised for extensive development.

Arrangements have been completed for the reorganization of the Black Warrior Mining Co., whose claims adjoin the property of the Bullion Beck mine. The Black Warrior company was launched many years ago, when a shaft was sunk to a depth of 300 ft., with a small amount of drifting, but in recent years it has been inactive. The company owns 32 acres of valuable mining ground, and has a capitalization of 250,000 shares with a par value of 50c. It is proposed to increase the number of shares to one million, and after the necessary funds have been raised, active development will be started, according to plans of Daniel Martin and William Hatfield, who own the control.

Organization of the Tintic Union Mining Co. to develop 496 acres of patented land in the East Tintic district, owned by W. C. Albertson of Salt Lake City, has been affected, and articles of incorporation filed with the Secretary of State. This property is in the vicinity of the Apex Standard, and is considered promising mining ground by engineers and geologists familiar with the district. Officers and directors of the new company are: W. C. Albertson, president and manager; George Haverkamp, vice-president; C. Q. Albertson, vice-president; George G. Armstrong, secretary and treasurer; A. G. Burritt, J. C. McClain, and I. G. Albertson.

A good lead of ore which has been followed for some time on the 1640-ft. level of the Eureka Lilly is showing improvement, according to Grant H. Snyder, general manager. Samples of ore taken recently from the face of the drift show from 18 to 25% copper, 10 to 14 oz. silver, and from \$4.50 to \$14.60 gold per ton.

BRITISH COLUMBIA

SHIPMENTS TO SMELTER AT TRAIL.

VICTORIA.—It is announced that the Consolidated Mining & Smelting Co. of Canada has taken over the Jordan River properties on Vancouver Island, known as the Sun-loch group. These have been under development for some time, about 1000 ft. of cross-cutting and drifting and 500 ft. of diamond-drilling having been done. Besides this there has been constructed some 6000 ft. of automobile road. A four-drill compressor plant has been installed and new buildings erected. A track also has been laid from the mine to the waterfront.

STEWART.—Native silver is reported to have been discovered on the cross-cut being driven on the E. Pluribus claim by William Noble, superintendent of the develop-

ment work in progress. The Big Missouri group, to which this claim belongs, has been considered to be an immense low-grade proposition but recent work has disclosed ore reported to contain silver in unusual quantity.

TRAIL.—Additions as well as some remodeling are under way at the Trail smelter of the Consolidated Mining & Smelting Co. An additional drafting office is being provided for the use of a staff of about twelve draftsmen who will be engaged in connection with the new concentrating plant which will probably be erected at Rossland. The site of the mill has not been definitely decided as yet, there still being a possibility that it will be placed at Trail, owing to the difficulty in obtaining a satisfactory water supply at Rossland. Sixteen properties shipped ore or concentrate to the Trail smelter during the week ending January 14, the total being 6510 tons. Included in these were three of the Clarence Cunningham properties, the Queen Bess, at Three Forks, and the Wonderful and Richmond-Eureka, at Sandon. For the first two



PRECIPITATING COPPER ON SCRAP-IRON AT THE LEACHING-PLANT OF THE UTAH COPPER CO., AT GARFIELD

ment work in progress. The Big Missouri group, to which this claim belongs, has been considered to be an immense low-grade proposition but recent work has disclosed ore reported to contain silver in unusual quantity.

KIMBERLEY.—A shoot of silver-lead ore, samples from which have assayed between \$101 and \$103, has been discovered by Robert B. Durrant while tunneling on a gold-bearing quartz vein on Perry creek. This galena orebody in a quartz lode is only one feature of the property and Durrant proposes sinking to 120 ft. to ascertain whether the orebody persists and, if so, to gain stoping ground.

SLOCAN.—The Silver Bell is reported to be showing up satisfactorily on further development. A new find is announced as a result of a raise from the lower tunnel. It consists of 12 in. of mixed ore, through which more or less clean ore is scattered. The indications become better as the work progresses. The Silver Bell has about 1000 ft. of work in its two tunnels and raise, the latter cutting ore about midway between the tunnels.

weeks of the year a grand total of 12,214 tons has been shipped to the smelter, which is considered an excellent start.

ONTARIO

CYANIDE PLANTS AT PORCUPINE EXEMPT FROM ASSESSMENT.

PORCUPINE.—An important decision has been made by the Ontario Railway and Municipal Board in a test case as to the municipal taxation of mine buildings. Under the Ontario Assessment Act mine buildings, including concentrators and stamp-mills, are exempt from assessment. It was claimed by the township of Tisdale in the Porcupine area that cyanide plants did not come under the head of concentrators, and were consequently assessable for taxation. This claim was resisted by the owners of the Dome, Davidson, McIntyre, and other gold mines, and after going through several stages of litigation the case was finally decided in favor of the companies. Good progress is being made in development at the Clifton Porcupine, where some high-grade ore has been en-

countered at the 200-ft. level. A substantial tonnage of commercial ore has been developed on the 100-ft. level, and lateral work is being done on the 200-ft. level to determine the extent of the downward continuation of the vein. At the Gold Centre exploration by diamond-drilling is being undertaken. So far no outcrops have been found on the surface, which is heavily overburdened. A new mill with a capacity of 250 tons per day is planned for the Davidson. Labor is becoming more plentiful enabling the Hollinger and Dome to increase their working forces.

COBALT.—Litigation over the Bailey mine, which has been in progress for six years, has been terminated by the decision of the Appeal Court directing the liquidators to complete the sale of the property to A. J. Young. A new company will be formed to take over both the Bailey mine and the Northern customs concentrator. The La Rose Consolidated has started cross-cutting on the 155-ft. level of the University property to tap two veins cut at the 100-ft. level which showed high-grade ore in places. A recent sale of 400,000 shares of Peterson Lake stock puts the company in a position to carry on an extensive exploration campaign. The workings of the Seneca-Superior and Gould properties have been dewatered and underground work started. Low-grade rock from the Seneca-Superior dumps is being profitably treated. The Waldman is now being operated by L. C. Campbell and associates of Montreal. At the Chambers-Ferland a substantial amount of low-grade ore is being developed in the No. 4 workings. A cross-cut is being run through that part of the property lying between the Nipissing and the La Rose, where some small stringers have been encountered. The tailing pile which has been optioned to H. Cecil and associates for \$55,000, is now being sampled.

GOWGANDA.—The McAlpine and Rawhide properties, situated about one mile north-east of the R. C. 101 claim of the Trethewey, have been taken over by a Toronto syndicate under the terms of an option. John J. Byrne is in charge and camp buildings are being built prior to the erection of mining equipment, now on the way. Several good veins have been uncovered on both properties, on each of which a shaft is down 100 ft. For the present, operations will be concentrated on the McAlpine where the shaft will be deepened. The North Cliff, a new company financed by Rochester capital, has taken over a group of claims $1\frac{1}{2}$ miles west of Gowganda townsite and begun active development. An adit will be driven into a high ridge where a series of veins have been uncovered on the surface. Norman F. Dye has been appointed superintendent.

KIRKLAND LAKE.—The annual statement of the Lake Shore company shows a deficit of over \$47,000 due to the strike. Mill heads averaged just below \$25, and production below \$300,000. The net profits were \$38,273, and \$100,000 was paid in dividends. During December 975 tons of ore was treated with a production of \$14,637.

TORONTO.—A merger has been effected of three prominent asbestos mines in Quebec province, owned by the Jacobs, the Federal, and the Berlin asbestos-mining companies. The new company under the name Con-

solidated Asbestos, Ltd., has a capitalization of \$10,000,000, of which stock for \$5,000,000 is issued, leaving \$5,000,000 in the treasury. The Jacobs mine is located at Thedford, and the Federal and Berlin mines at Robinsonville. Sir John W. Carson, who becomes president and managing director, is one of the most prominent mining men of Canada and largely interested in Northern Ontario enterprises, being president of the Crown Reserve and Porcupine Crown companies.

The twenty-second annual general meeting of the Canadian Mining Institute will be held at the King Edward hotel, Toronto, on Monday, Tuesday, and Wednesday, March 8, 9, and 10.

SONORA

DEAL PENDING FOR SALE OF CANARIO COPPER CO.

NACOZARI.—The Canario Copper Co., whose property is situated at the apex of a triangle, at a point five miles north-west of Pilares de Nacozari, and five miles south-west of the town of Nacozari, is believed to have proved the existence of a large hitherto undeveloped mineral belt lying between the Pilares orebodies and the Lily-Segundo of the Canario. The orebody on the 300-ft. level had previously been proved to be 100 ft. in width, with the grade of ore improving constantly. The cross-cut had to be abandoned temporarily owing to the flooding of the working by a large chamber of water, lying just beyond the foot-wall. The existence of this body of water was known and workmen had been warned against puncturing the talc foot-wall. However, one of the Mexican miners, overcome by curiosity, drove a bar through it and pried away a section. He and a companion working in the drift had a narrow escape from drowning in the deluge that ensued. For two weeks bailing and pumping at top speed had to be done before the 300-ft. drift could be entered again. Since that time the west drift has followed the same orebody, proving it to be at least 400 ft. in width. A party including George F. Shurtleff, consulting engineer with Cameron, Michel & Co., G. Henry Stetson, of the Stetson Hat Co., Stephen B. Bourne, former secretary of the Emergency Fleet Corporation, and Charles D. Donning, a mining engineer of Prescott, Arizona, visited the property and inspected the mine. The Nacozari Consolidated, on the other side of the Pilares mine of the Motezuma Copper Co., has started three cross-cuts in its main tunnel, which is in the Pilares mineral zone. Two of these are being driven along the orebody. The third is driving toward another contact. The company recently began using mule trains for handling waste and ore in the main tunnel, each mule drawing a train of five cars.

PILARES DE TERAS.—A deal involving the sale of the Cinco de Mayo mine to an American syndicate is reported to be pending. The price is said to be \$500,000. The mine is reputed to be one of the richest silver properties in northern Sonora, and was operated under government management for a time, but unscientific methods, combined with notorious grafting on the part of some employees, created a loss that resulted in shutting down.



ARIZONA

Ajo.—Notwithstanding production was curtailed last year to a bare 60% capacity, due to the abnormal conditions obtaining in the metal market, the New Cornelia Copper Co. produced copper at a cost of 13c. per pound. This figure is exclusive of a reserve for ore depletion and excess-profits taxes. The company produced approximately 40,000,000 lb. of copper in 1919, or about 8,000,000 lb. less than in the preceding year. New Cornelia has been a commercial producer only since the middle of June, two years ago. Beyond the construction of its 500-ton experimental flotation plant, New Cornelia was not obliged to do any building or plant enlarging last year. Experiments thus far with the flotation process have been satisfactory and the company will probably take a definite step in the direction of using the system in the not distant future.

Mayer.—Copper mountain has another shipper which has come into this class within the past few weeks. It is the Franco American company's mine which is situated about one and a half miles north-east of the Arizona Binghamton. Fred Bowler, of Prescott, took over this old property during last year and organized the company. Former owners shipped four carloads of high-grade copper, the lowest car averaging 22% and the highest 35% copper and about \$10 in gold and silver. The mine, when taken over by the present company, had been developed by an incline shaft 250 ft. deep with levels on the 125 and lowest stations. The mine is now being developed on an extensive plan. New equipment has been installed at the shaft for deep sinking, the plan being to put the work down to the 1000-ft. level. There are several carloads of high-grade ore on the dump ready for shipment and as soon as the new truck road is completed to the mine one or two carloads per week will be shipped from Dewey.

CALIFORNIA

Corning.—Clarence Wolf and J. D. Overstreet report the discovery of copper-silver-gold ore in the mountains west of Corning. Prospecting has been carried on for several months and a strong orebody is said to be exposed.

Nevada County.—W. A. Stutsman of Los Angeles is at Meadow Lake inspecting the Excelsior mine with a view to its purchase. The property is owned by Peter Bokay. The water in the old Idaho-Maryland shaft is now below the 600-ft. level and is being lowered rapidly. Between the 200 and 400-ft. levels the shaft was found to be in a bad condition and a large amount of re-timbering was found necessary. No mining of consequence will be attempted until the 1000-ft. shaft is unwatered. The county recorder filed 1077 exemption-claim notices for 1919.

Placer County.—The Rising Sun mine near Colfax is being re-opened by a company headed by John Zeeman of San Francisco and Messrs. Russell, Loebner, Gray, and Klinker of Colfax. The mine is unwatered below the 500-ft. level, two 50-hp. electrically-driven centrifugal pumps being used for that purpose. The four-compartment shaft is 800 ft. deep. The mine closed in the early 'eighties due to litigation. The Rising Sun has a production record of over two million in gold. The company has applied for permission

to sell 50,000 shares of treasury stock for the purpose of building a mill and exploring the mine.

Tailorsville.—Trask & Coffey Co. has resumed operations following the receipt of machinery and improvement in the labor situation. The management plans work on a larger scale and reports a deposit of rich copper ore. Diamond-drills are reported to have exposed a 7-ft. vein of 32% copper ore in the Walker mine, controlled by the Anaconda Copper Co. Driving of the cross-cut from 400-ft. level of Gruss mine is proceeding rapidly and the orebody should be intersected shortly. An eight-drill compressor has been added to equipment; 22 men are employed under the management of W. J. Gruss.

COLORADO

Cripple Creek.—Royalties aggregating \$60,326 were paid the United Gold Mines Co. from ore shipments by lessees, during the last fiscal year, according to the report mailed to stockholders, along with their dividend checks; \$40,000 was disbursed at the rate of 1c. per share. An electric motor has recently been installed at the old Victor mine on Bull Cliffs, by the Komat Leasing Co., a local organization operating the property and the Arvilla group adjoining. The Victor is controlled by the Smith-Moffat Mines Co. An additional electric compressor of 10-drill capacity has been added to the equipment at the No. 2 shaft of the Modoc Consolidated company, preparatory to development of the Combination claim, north-west of the Last Dollar mine, on which the No. 2 shaft is situated.

IDAHO

Coeur d'Alene.—The Big Creek section, commonly known as the 'dry ore belt', is attracting attention on account of the unusual amount of work now under way, and by reason of several recent transactions involving properties in the locality. As a result of consolidation of the Big Creek Leasing Co., holding a lease on the Yankee Boy mine, with the Big Creek Silver Mining Co., active work has now started in the Yankee Boy lower levels. Adjoining the Yankee Boy lies the property of the Yankee Girl Mining Co., now under bond to E. C. Tousley of Spokane. It is stated that work will soon be under way on this property. The Sterling Silver Mountain company has surface showings said to indicate exceptional values in silver in a 20-ft. vein, which will be reached at a depth of 300 ft. by the present cross-cut. Another effort is to be made to find orebodies in the National mine, above Mullan. Operations are to be resumed as soon as a crew can be secured. The Star Creek Mining Co. will ship a 50-ton car of crude ore to the Bunker Hill smelter at Kellogg, as soon as the work of loading has been completed. The ore will assay approximately 65% in lead, with about 8 oz. of silver per ton, it is said. The Federal Mining & Smelting Co. has obtained admission to the workings of the Hecla Mining Co. at Burke, and its engineers are engaged upon a survey. The Ajax Mining Co., operating at Burke, has found ore in that part of its property adjoining the Hercules, according to an official. This is at a depth of 750 ft. and at a point 650 to 700 ft. east of the line that divides the Ajax and the Hercules.

**RESOLUTION UNANIMOUSLY ADOPTED BY THE JOINT
COUNCIL OF ENGINEERS OF SAN FRANCISCO,
JANUARY 13, 1920**

Whereas, There is at this time a strong and wide-spread sentiment for Herbert C. Hoover for President of the United States as an independent candidate, free from political deals and pre-election pledges; and

Whereas, Mr. Hoover, by his work in Europe, has shown executive and administrative abilities of the highest order, particularly fitting him for handling both the economic problems of reconstruction at home, and our relations with other nations; and

Whereas, The Joint Council of Engineers of San Francisco has a patriotic duty to perform at this time, not only as representing Engineers, but also as a representative body of American citizens; be it therefore

Resolved, That the Joint Council of Engineers of San Francisco, representing 2000 Engineers in the Bay district, endorses Herbert C. Hoover for President and invites the engineering bodies of the United States to join with it in forming an organization to further Mr. Hoover's election, and in such other activities as will insure the affairs of the Nation being handled on an efficient and non-partisan basis, and be it further

Resolved, That copies of this resolution be sent to all engineering organizations and technical journals throughout the United States, and that such other steps be taken as will further the movement of "Hoover for President".

OBITUARY

John H. McChrystal, 57 years of age, one of the most widely known mining men of Utah, died at his home in Eureka, Utah, on January 27. Pneumonia was the cause of his death. He was manager of the Gemini Mining Co., the Ridge & Valley Mining Co., and the Godiva Mining Co., all in the Tintic mining district. He was a native of Franklin, Michigan, and came to Utah in 1875. Early in life he entered the mining business, in which he achieved considerable success. He was a member of the American Institute of Mining & Metallurgical Engineers. He is survived by a wife, two daughters, and one son.

Darsie C. Bard died of pneumonia at Butte on January 23. He was taken ill while underground in connection with the Elm Orlu litigation. He was born in 1878 and graduated from Harvard in 1904. Shortly after he went to Butte and became a member of the geological staff of the Anaconda Copper Co. In 1909 he was appointed professor of geology in the Montana State School of Mines, retaining this position until 1916, when he became consulting engineer to the Chicago, Milwaukee & St. Paul Railroad company. In 1917 he joined the staff of the British Columbia Smelting Co., with headquarters at Seattle. He contributed to the technical press and played a generous part in all professional activities.

Kurnal R. Babbitt, widely known corporation attorney, died at his home in New York City on January 23, at the age of 56. For a number of years past, he was general counsel of the various mining and railway companies which are under the general direction of D. C. Jackling, including the Utah Copper Co., Ray Consolidated Copper Co., Chino Copper Co., Nevada Consolidated Copper Co., and Butte & Superior Mining Co. He began the practice of law at Aspen, Colorado, in 1891, and later opened law offices at Cripple Creek, where he became acquainted with C. M. MacNeill, now president of the Utah Copper Co. When the Utah Copper Co. was organized in 1903, Judge Babbitt became associated with it as general counsel. In 1908 he moved his offices to New York City. Funeral services were held at New York City on January 26 at 3:30 p.m. Operations were suspended for five minutes, beginning at that time, at all of the Jackling properties in the United States.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

W. L. Zeigler, of Seattle, has gone to Latouche, Alaska.

Leverett Davis, of Denver, was in San Francisco last week.

A. J. Taylor, of Vancouver, was in San Francisco last week.

E. P. Mathewson is now at Vancouver, B. C., and will be in San Francisco shortly.

Charles W. Goodale was here last week to meet his brother **William Goodale**.

Albert Burch has returned from a journey to Alaska. He is now at Oatman, Arizona.

Philip Argall will sail from Vancouver to Sydney by the 'Niagara' on or about February 15.

F. K. Brunton has recently taken charge of the La Prieta mill near Culiacan, in Sinaloa, Mexico.

L. S. Cates, with **D. D. Moffat**, made a tour of inspection of the Ray Con. Copper Co.'s properties in Arizona.

L. F. S. Holland is examining mines in Colorado, and expects to return to Los Angeles about the middle of February.

George C. Riser, superintendent of the Nevada Con. Copper Co.'s concentrator at McGill, was at Salt Lake City recently.

Richard A. Parker has been re-elected chairman of the mining bureau of the Civic and Commercial Association, at Denver, Colorado.

R. W. Mumford is chemical engineer in charge of development at the American Trona Corporation plant at Searles Lake, California.

Raymond Fennell, a director of the Central Mining & Investment Co., London, has been visiting mines and metallurgical plants in Utah recently.

H. S. Emlaw has been appointed general manager for the American Trona Corporation in California, and **Frederick Vieweg** the assistant general manager.

Paul Paine has severed his connection with the Gypsy Oil Co. to engage in the examination and appraisal of oil-lands. His address will be Box 1008, Tulsa, Oklahoma.

Vernon S. Rood, manager for the Utah Apex Mining Co., was married on February 3 in San Francisco to Miss Josephine Lindley, the daughter of Judge Curtis H. Lindley.

H. W. Morse has resigned from the position of technical manager for the American Trona Corporation and accepted the position of consulting physical chemist to the same company.

G. W. Miller has returned to Los Angeles from the Vulture mining district in Arizona, where he has been examining the United Grande Mines Co.'s property near Hot Springs Junction.

J. A. L. Gallard, who was mining editor of the 'Financial Times' for 18 years, has joined the staff of the 'Mining Magazine', as associate editor, and will take up his duties in February.

C. R. Olson, formerly mill-superintendent for the Como Consolidated Mines Co., has resigned to accept a similar position with the Kansas City-Nevada Consolidated Mines Co., at Bruner, Nevada.

H. Sato, mining engineer, of Tokyo, Japan, is in Utah, visiting mining and metallurgical plants. During the past six months he has seen all of the large mining camps in Canada and the United States, and is now on his way home.

THE METAL MARKET



METAL PRICES

San Francisco, February 3

Aluminum dust, cents per pound.....	65
Antimony, cents per pound.....	12.00
Copper electrolytic, cents per pound.....	19.25
Lead pig, cents per pound.....	8 75-9 75
Platinum, pure per ounce.....	\$155
Platinum 10% iridium, per ounce.....	\$180
Quick-silver per flask of 75 lb.....	\$85
Spelter, cents per pound.....	11.00
Zinc-dust, cents per pound.....	12 50-15.00

EASTERN METAL MARKET

(By wire from New York)

February 2—Copper is inactive and steady. Lead is dull but firm. Zinc is quiet and easier.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fines) in British currency is 46.63 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
Jan. 27.....	134.00	82.25	Dec. 23.....	133.56	78.08
" 28.....	135.00	84.25	" 30.....	132.50	76.87
" 29.....	135.50	85.00	Jan. 6.....	130.80	76.19
" 30.....	134.25	84.12	" 13.....	133.71	79.49
" 31.....	133.00	83.00	" 20.....	132.04	78.81
Feb. 1 Sunday.....			" 28.....	132.58	80.00
" 2.....	134.50	84.37	Feb. 2.....	134.37	83.83
Monthly averages					
Jan.	1918 88.72	1919 101.12	1920 132.77	July	99.62 106.36
Feb.	85.79	101.12		Aug.	100.31 111.35
Mch.	88.11	101.12		Sept.	101.12 113.92
Apr.	85.35	101.12		Oct.	101.12 119.10
May	90.30	107.23		Nov.	101.12 127.57
June	90.50	110.50		Dec.	101.12 131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending	Cents	Pence
Jan. 27.....	19.25	Dec. 23.....	18.75
" 28.....	19.25	" 30.....	18.92
" 29.....	19.25	Jan. 6.....	19.25
" 30.....	19.25	" 13.....	19.50
" 31.....	19.25	" 20.....	19.16
Feb. 1.....	19.12	" 28.....	19.08
" 2.....	19.25	Feb. 2.....	19.23
Monthly averages			
Jan.	1918 23.50	1919 20.43	1920 19.25
Feb.	23.50	17.34	
Mch.	23.50	15.05	
Apr.	23.50	15.23	
May	23.50	15.91	
June	23.50	17.53	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
Jan. 27.....	8.75	Dec. 23.....	7.25
" 28.....	8.75	" 30.....	7.53
" 29.....	8.75	Jan. 6.....	8.05
" 30.....	8.75	" 13.....	8.73
" 31.....	8.75	" 20.....	8.75
Feb. 1.....	8.75	" 28.....	8.75
" 2.....	8.75	Feb. 2.....	8.75
Monthly averages			
Jan.	1918 6.85	1919 5.60	1920 8.65
Feb.	7.07	5.13	
Mch.	7.26	5.24	
Apr.	6.99	5.05	
May	6.88	5.04	
June	7.59	5.32	

TIN

Prices in New York, in cents per pound:

Date	Average week ending	Cents	Pence
Jan.	1918 85.13	1919 71.50	1920 62.74
Feb.	85.00	72.44	
Mch.	85.00	72.50	
Apr.	85.83	72.50	
May	100.01	72.50	
June	91.00	71.83	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending	Cents	Pence
Jan. 27.....	0.45	Dec. 23.....	8.06
" 28.....	0.45	" 30.....	8.00
" 29.....	0.45	Jan. 6.....	0.42
" 30.....	0.45	" 13.....	0.75
" 31.....	0.35	" 20.....	0.59
Feb. 1.....	0.35	" 28.....	0.54
" 3.....	0.35	Feb. 2.....	0.41

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.	7.78	7.44	9.58	Aug.	8.72	7.78	...
Feb.	7.97	6.71	...	Sept.	8.78	7.81	...
Mch.	7.67	6.53	...	Oct.	9.58	7.57	...
Apr.	7.04	6.49	...	Nov.	9.11	7.82	...
May	7.92	6.43	...	Dec.	8.75	8.12	...
June	7.92	6.91	...		8.49	8.69	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Jan. 20.....	90.00
Jan. 6.....	85.00	27..... 90.00
" 13.....	90.00	Feb. 2..... 85.00

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.	128.00	103.75	89.00	Aug.	120.00	100.00	...
Feb.	118.00	90.00	...	Sept.	120.00	103.00	...
Mch.	112.00	72.80	...	Oct.	120.00	102.60	...
Apr.	115.00	73.12	...	Nov.	120.00	86.00	...
May	110.00	84.80	...	Dec.	120.00	78.00	...
June	112.00	94.40	...		115.00	95.00	...

MONEY AND EXCHANGE

Bankers are looking with a good deal of interest upon the movement, which appears to be growing, of floating well-known foreign securities in this market through issuing 'American shares' secured by deposit here of certain foreign shares. This is regarded as offering the most potent remedy, ultimately, for the foreign-exchange situation. Present movement is the more significant because it is spontaneous and not induced by artificial measures to relieve the situation.

It has been pointed out that the present position of sterling and the other important exchanges can be remedied only by a flow of capital from the United States to Europe. Extensions of loans and credits only postpone the day of final settlement. With Europe in need of continued large supplies of our raw material and heavy indebtedness to this country for money borrowed, the credit balance against Europe will remain heavy for a long time to come, and this balance will consequently be reflected in a depreciation of foreign exchanges in this market.

But this depreciation of the foreign exchanges is not without its benefit to the European countries. Prevailing discount is an inducement for investment of American capital abroad. Movement means the salvation of security values on the other side, where, on account of the huge emissions of government war loan securities, markets are saturated beyond the investment demand. Particularly is this situation beneficial to Great Britain, and so far movement of foreign securities here since the War has been confined for the most part to the offering of British industrial securities. The position of sterling and reputation of certain British industrials have made a strong appeal to American investors.

The innovation of offering 'American shares' against foreign stock as collateral really came while the War was in progress, when, in December 1916, 222,000 'American shares' were issued against 74,000 sub-shares, or 7400 full shares, of Royal Dutch Co. stock deposited in New York. But this operation did not present the same opportunities for profit on the exchange as have since appeared with the British issues floated since the termination of hostilities. Consequently a good many of the 'American shares' have since been bought up by Dutch interests and the amount of Royal Dutch shares here considerably reduced. Early last summer 277,000 'American shares', each representing two original shares of Shell Transport & Trading Co., were offered in this market. A short while ago, 60,000 'American shares', each representing 2½ original shares of Rand Mines, Ltd., were sold here.

Bankers believe this movement will become more extensive as time goes on. Listing of foreign securities on our exchange as a means of inducing the flow of American capital abroad is advocated. Bankers point out that this is the reversal of what happened subsequent to our Civil War when European capital flowed to this side to finance the railroad expansion of the United States and 'American rails' became a feature on the London Stock Exchange. Offering of foreign securities in this market in the coming years, it is believed, will make a considerable part of European industries indebted to American investors.

Foreign exchange quotations on February 3 are as follows:

Sterling, dollars:	Cable	3.37
	Demand	3.38½
France, cents:	Cable	7.12
	Demand	7.11
Lire, cents:	Demand	6.06
Marks, cents:	Demand	1.18

Eastern Metal Market

New York, January 28.

The markets continue generally quiet, with demand light in most of them. Prices are firm to easy.

Copper demand is fair and prices are steady.

The tin market has been quiet and sales have been light.

Demand for lead is decidedly lighter but prices are strong.

Prices for zinc are a little lower and demand is less.

There is some price-cutting.

The antimony market is strong and advancing.

IRON AND STEEL

The pig-iron market has turned active. Prices having advanced to \$40, Valley, for basic, \$41 for Bessemer, and \$40, Birmingham, for No. 2 foundry. Furnaces are willing to sell and buyers have not hesitated to contract for large quantities even over the second half. Because of higher ore, coke, and freight rates, the cost of making iron is likely to advance in the near future.

The surprise of the week has been the eleventh hour decision of the Railroad Administration to secure maximum delivery of rails the coming month. Falling back on the technicality that we are still at war, orders of the war-time type have been issued on all rail-mills for a tonnage which will probably keep them busy for several months. The statement of earnings for the fourth quarter, made public today by the Steel Corporation, was a surprise, the net profit being far ahead of expectation. It is about \$35,000,000 against the most optimistic estimates of \$31,000,000.

COPPER

A better inquiry is reported than last week but the market is generally quiet. Producers or first hands continue to ask not less than 19.25c., New York, for electrolytic and 19.50c. for Lake for early delivery. It is reported that second hands are offering electrolytic as low as 18.75c., New York, for early delivery, due to the fact that they must close their accounts against deliveries of the metal. It is believed that the supply from this source is small. The tone of the market is strong and a better market is predicted by some for the near future. Because of the weakness in exchange values exporters are not pressing the market. Copper exports for 1919 are estimated at 226,611 gross tons against 328,844 tons in 1918 and 493,256 tons in 1917, the largest in the last five years.

TIN

The week has been a quiet one. Only light sales are recorded and at a lower level, due to some extent to the slump in exchange. The possibility that banks are calling loans is suggested as one cause of the selling, holders of the metal desiring to cash in. It has been a slow market. On Monday there was a little inquiry with the market easy, future shipment from the East being offered at 63.25c. and spot shipment at 62.75c. with bids reported at 62.50c. Because of record low levels in exchange yesterday, spot Straits was quoted as low as 62.25c., New York. Arrivals for the month have been 3895 tons, of which 610 tons came in at Pacific ports. Tin afloat is reported as 5155 tons. The London market yesterday was £393 per ton, an advance of £7 per ton during the week.

LEAD

This market has become decidedly quiet and there is little or no demand. In a very few quarters some disposition to sell is in evidence and prompt lead is offered as low as 8.45c., St. Louis. Lower bids, perhaps 8.25 to 8.37½c., would result in business. Prompt lead, which was almost

unobtainable at 9c., New York, a few weeks ago, is now quoted at 8.75c., New York. The general market for early delivery is 8.45c., St. Louis, or 8.75c., New York, with the American Smelting & Refining Co.'s quotation unchanged at 8.25c., St. Louis, or 8.50c., New York.

ZINC

Most of the large producers are well sold up through the first quarter and are not forcing the market. Inquiry from galvanizers has been good, particularly for early delivery, and these needs have been taken care of in most cases. These producers are generally quoting prime Western at 9.10c., St. Louis, or 9.45c., New York, for early delivery. There is one large broker, however, who is offering at 9 to 9.10c. for early delivery, but says business is difficult to get. The fluctuations and lower levels in exchange have had their effect so that the slight reaction now prevailing is not a surprise. The lower exchange rate has been partly offset with slightly higher prices in London. Some of the labor troubles in the West have been adjusted.

ANTIMONY

The market is much stronger. Wholesale lots, five tons and more, are quoted at 11.25c., New York, duty paid, for early delivery, and the metal is scarce.

ALUMINUM

There is no change. Quotations for early delivery of wholesale lots are unchanged at 31.50 to 32.25c., New York.

ORES

Tungsten: The market is absolutely inactive, awaiting possible action of the Senate on the tariff question. Some expect a decision this week. Chinese ore is offered as low as \$6 per unit and the range on other grades is up to \$15 per unit. Quotations are nominal, sellers being inclined to hold their supplies which would increase in value with the passage of a tariff. Ferro-tungsten is nominal at around \$1 to \$1.15 per lb. of contained metal.

Molybdenum: Quotations are unchanged at 75c. per lb. of MoS₂ in 90% concentrates. The market is dead.

Manganese: As high as 80c. per unit has been paid for foreign ore. The market is strong and ores are scarce.

Manganese-Iron Alloys: The markets for both ferro-manganese and spiegeleisen are very strong. For the latter a maximum of \$57.50, furnace, is now asked and sales of several hundred tons have been made at \$55. For export 500 tons has gone to Belgium and 1000 tons to Holland, the price for the latter having been \$58.25. Sales of about 1000 tons of ferro-manganese from a recent new producer are reported at \$150 to \$160, delivered, for delivery to July 1. For last half domestic makers are talking \$160, delivered. For the present they are out of the market. One representative of a British producer has 2000 to 3000 tons for delivery during May or later at \$145, seaboard, and another has 500 tons held at \$150, seaboard.

Some chrome ore, according to Charles Hardy, Inc., Park Row building, New York, has been offered for shipment from abroad, but almost invariably business has been held up for want of arranging satisfactory freight. Indian chrome ore now on the way to the United States is offered at 75c. per unit for material running about 50%. At this figure further quantities can no doubt be contracted for. The same firm gives a nominal quotation for quicksilver at \$93 per flask, adding that it has, however, been possible to buy at a considerable concession from this figure.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 120 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, FEBRUARY 14, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

Page

EDITORIAL

NOTES	215
A FALL IN EXCHANGE	217

The price of gold and silver in London and New York. Difference due mainly to the fall in exchange. A serious crisis. Our export business endangered. Drain on credit. The part played by our foreign trade. Results of a decrease of exportation. Our relation to Europe, the inter-dependence of the civilized countries. Chinese walls are out of date.

THE LICENSING OF ENGINEERS	217
----------------------------------	-----

Engineering Council and the good work it has been doing. A model law for licensing engineers, architects, and surveyors. Outline of the report on the proposed law. Various enactments already in effect. The license law of Illinois. Details of the bill drafted by Engineering Council. Qualifications of engineers. Revocation and renewal of licenses. Co-operation between engineering societies.

DISCUSSION

DE-GASSING CYANIDE SOLUTIONS	
------------------------------	--

By Philip Argall

219

Fifteen inches of vacuum will de-gas solutions. Submerged vacuum-filter best means available for clarifying.

THE CROWE PROCESS	
-------------------	--

By N. S. Keith

219

'Crowe patent' more accurate than 'Crowe process'. Nothing in the method really patentable. Mr. Crowe should have credit for giving prominence to virtues of de-aeration.

ENGINEERING EMPLOYMENT BUREAUS	
--------------------------------	--

By C. E. Drayer

220

Attention drawn to a misleading statement regarding employment work, made by Bradley Stoughton and quoted in an editorial in the 'Press'.

ARTICLES

SOME IDEAS ON BALL-MILL PRACTICE	
----------------------------------	--

By Curtis Lindley, Jr. 231

An ingenious application of the mathematical law of probability and chance to grinding in ball-mills. Effect of dilution. The principle crushing action; a novel theory.

THE COTTRELL PROCESS IN JAPAN	
-------------------------------	--

By Ritaro Hirota and Kyoshi Shiga. 233

Preliminary experiments in Japan. Part played by the Metallurgical Research Institute. Plants using Cottrell treaters in Japan.

MINING AND MILLING TIN-TUNGSTEN ORE IN TASMANIA	
---	--

By Wm. E. Hitchcock and J. R. Pound. 229

Geology of tin-tungsten lodes. Mine operations. Details of stoping methods. Concentrating plant and equipment. Water-power utilized.

REGISTRATION OF ENGINEERS	232
---------------------------------	-----

An abstract of a report submitted to Engineering Council by its committee. Existing legislation. Future legislation should be guided by engineers. A standard State law recommended. Provisions of this law. Qualifications for registration.

NOTES

'PANEL' STOPES IN SOUTH AFRICA	222
--------------------------------------	-----

DEPARTMENTS

REVIEW OF MINING	237
------------------------	-----

THE MINING SUMMARY	245
--------------------------	-----

PERSONAL	246
----------------	-----

THE METAL MARKET	247
------------------------	-----

EASTERN METAL MARKET	248
----------------------------	-----

DIVIDENDS FROM MINES, UNITED STATES AND CANADA	249
--	-----

COMPANY REPORTS	250
-----------------------	-----

INDUSTRIAL PROGRESS	251
---------------------------	-----

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



Scrapped? No; Oxwelded!

TOTAL loss, you'd say—derrick out of business indefinitely, until new side bearing member arrived. Not so. It was oxwelded—in a few hours—at an insignificant cost.

Now there is an oxwelder in every crew—a complete welding and cutting equipment on every contract before it starts.

*No job too big—no job too little for Oxweld
It pays its way every day*

OXWELD ACETYLENE COMPANY

NEWARK, N. J. CHICAGO LOS ANGELES

World's Largest Maker of Equipment for Oxwelding and Cutting Metals



TRADE with our excellent neighbors and customers, the Canadians, is suffering from a discount of 17% on their dollar. Is it not time to repeal the embargo on the exportation of paper pulp from across the line? We need it greatly, as abnormal prices and unrestricted profiteering indicate so uncomfortably. Why does the Canadian government hesitate to do the obvious?

FOOD-DRAFTS are being sold as a means of affording Europeans in this country a convenient and safe way of aiding their friends in the war-devastated countries. This method has the advantage of being operated without coming within the incidence of taxation or necessitating large credits. The burden of these drafts will be borne by the three or four million of our population that retain family ties in Europe. The money used in purchasing food-drafts would otherwise be remitted to Europe either by money-draft or in paper currency, and would be of little use so far as the purchase of food is concerned, because there is none available outside that controlled by the governments and the supplies of the American Relief Administration. All other food is subject to requisition. This information should be given to alien laborers at mines and mills. Write to the office of the Relief Administration at 115 Broadway, New York. Mr. Herbert Hoover is chairman and Mr. Edgar Rickard is acting as secretary.

HEARST and his yellow journals are advocating a new party with the slogan 'Hearst first', in order to save the country from the bold bad men who do not appreciate him and his trickeries. That might be a good idea, if only we could have another party headed by Herbert Hoover. The two men could stand for opposing ideas, which is more than can be said now for the politicians of the two old parties. The frothy provincialism of the man who has befouled American journalism would afford a fine contrast to the intelligent humanism of the man who has proved his extraordinary administrative ability in great works of beneficence, both abroad and at home. However, as Mr. Hoover suggests, two parties is enough; the old ones are still in evidence. We publish a statement from Mr. Hoover on page 246. It speaks for itself; it is sane and sagacious. He says clearly that he is neither a reactionary nor a radical; he stands for orderly progress in national affairs; also for the League of Nations, with minor reservations. He waits for the national parties to declare their platform; until then he cannot commit him-

self further. Why should he? Meanwhile we venture to suggest another reason for reticence on his part; he is acting chairman of the Industrial Conference, which is a non-partisan body engaged in work of the highest importance.

SENATOR SMOOT has been denouncing the waste of print-paper by the executive departments of the Federal government; he deplores the cost of printing and distributing the speeches of Mr. McAdoo and other Cabinet officers during the War. Here we detect a jaundiced eye; many of those speeches served a distinctly useful purpose in arousing national sentiment; even a Republican might concede that. The wastage is not all there; it extends to Congress itself, notably the 'Congressional Record' and the re-printing of speeches delivered by honorable senators. No sign of economy is evident. All the scribbling paper we use is supplied by Government departments, which send us daily multi-graphed circulars that are typed on one side, leaving the other for what, to us, seems a better service. We hear about the price of paper, which is exorbitant and prohibitive, but we hear too little about the waste of it by officials and newspapers all over the country.

LAST week we discussed various efforts, by means of State and Federal legislation, to prevent fraudulent promotion. We note how the law is being evaded by selling, not shares in a company, but other units conferring participation in speculative projects. For example, the New York Brokerage Co. of Shreveport, Louisiana, offers to sell an 'oil lease'. A remittance of \$100 sent to the San Francisco office of this company—which has borrowed the name of New York—will buy a six-acre lease near New Homer, in Louisiana. The lease will be made out in the remitter's name and will be recorded in the Recorder's office, without further charge. The advertisement says that these are "commercial leases and run from three to five years with option of renewal by payment of one dollar or so per acre". The language seems studiously vague, except as to urgency; if one wants to make money quickly, one must hurry, says the advertisement. "There is no time to 'take the matter under consideration'. It is men of quick action, men who do things [and people] as the late Jay Gould did them, 'right now', who make the big profits in oil." Therefore, concludes this impudent screech, "Send along your order before you lay this paper down". The same

irresponsible newspaper prints several similar advertisements. One is headed, "Millionaires Made Over Night!" This one invites correspondence, offering to show how the "syndicate plan" will ensure a fortune to the simpleton who invests in "our leases". A third offers 9-year leases at \$10 per acre, sold in 10-acre tracts or more. "These leases are all drawn up legally on regular Form Commercial lease, same as big Companies use." A fourth invites the gullible to "send in your check or money order for \$100 to cover what you can afford to buy at \$12 per acre, either two and one-half or ten acres. I'll send you a legal assignment of the same ready to be mailed for recording, a large map of Texas, showing the location of the property and its proximity to producing and drilling wells, together with a copy of the official plat of the subdivision with your tract number and location plainly marked." Why not send a pound of tea also? A fifth spieler offers "a 1-acre oil lease in surveys 351 or 352 for only \$15.00; or a 5-acre oil lease for \$65.00. This price will surely advance next week and then you may be sorry if you don't buy now." We quote verbatim. This sort of thing is outside the scope of any existing blue-sky laws, because no shares or bonds are offered. Apparently there is need for a law that will take cognizance of such methods.

IT is interesting to observe that at a recent Safety-First convention, the Calumet & Arizona company at Bisbee was able to award prizes to 16 of its 28 underground shift-bosses for attaining a perfect record in respect to such injuries as incapacitated men working under their immediate direction. This record covered the year 1919, and applies only to bosses with a minimum of 2500 shifts to their credit. The company also announces that during the year there was a decrease of 57% in the number of accidents as compared with 1914. At another large property a decrease from 4.2 to 1.8 disabling injuries per 10,000 shifts worked is attributed directly to the introduction of an efficient safety organization. These are typical of scores of mines where remarkable results are credited to the Safety-First movement. Underground mining operations entail an inherent and undeniable element of hazard, over and above that to which workmen in many other industries are exposed. The work is necessarily done in artificial light, and much of it even in an inferior kind of artificial light, owing to the impracticability of distributing electric current outside the main levels. Moreover, operations always resemble construction work in that the miners are continually engaged on temporary floors, with danger lurking above, their heads as well as at their feet. Daily travel through a shaft in an open cage and the continual handling of high explosives are features characteristic of the occupation of the miner. The attitude of most mining companies ten or fifteen years ago was to recognize the distinctive dangers of the industry and accept as inescapable a high proportion of accidents resulting in injury and even death; now the danger is recognized as before, but the effect is rather to emphasize the need for more than ordinary application of safety methods

and teachings. It is a fact that the accident records in plants for the manufacture of dynamite and other high explosives are notably low, although it can scarcely be maintained that the element of risk is not extraordinary. The explanation is simple. Because the hazard is clearly recognized, the necessary precautions are taken and safety rules are observed as a matter of course. This idea is the basis for safety propaganda in mining. There are two distinct phases of the work: the first includes the planning of operations so that they can be performed in a safe way; the selection of equipment of approved design; the provision of mechanical safeguards; the posting of rules and of directing-signs; and similar precautions, which involve, principally, the outlay of money. The more difficult part of an effective program is that of educating the workers themselves. Miners are prone to be careless, more so perhaps than men engaged in other occupations. Some are inclined to look with a kind of contempt at warnings; some conclude that the measures taken by the company are so elaborate as to eliminate danger, and therefore make individual care superfluous. However this may be, the recognized problem is to get co-operation and to educate each miner so that he instinctively and habitually does his work in the way that is safe for him, safe for the man working with him or under his direction, and safe for the man who next may be engaged on the same job or in the same vicinity. Originally a slogan, 'safety first' has become an institution, and every progressive mining company sees in it not only a source of financial gain but a humanitarian movement for the preservation of life and health. It is one ground at least on which capital and labor can meet with mutual goodwill.

WE have received further, semi-official, information concerning the Premier mine, in the Salmon River district of British Columbia. It appears that last October an examination of the mine was made by Mr. H. A. Guess and other engineers of the American Smelting & Refining Company's mining department, in conjunction with Mr. H. B. Price, engineer for Messrs. Minor C. Keith and Isaac Untermyer. In consequence of a favorable report a 52% interest was purchased by the principals mentioned from the owners, namely, Mr. R. K. Neill of Spokane, and Messrs. Wood, Trites, and Wilson of Fernie, British Columbia. The management of the enterprise rests with the American Smelting & Refining Company. The present program is to ship the high-grade ore, while erecting a small mill for concentrating the lower-grade ore on tables and by flotation. The upper adit is now 600 feet long; it shows, in addition to mill-ore containing patches of shipping grade, two orebodies rich in silver and gold, each of these ore-shoots being the width of a drift or better, and about 70 feet long. The ore of one averages \$100, as broken; the other, about \$200 per ton. These orebodies follow a fissure that may prove to be one wall of a large lode. The exploratory work as yet is insufficient to indicate to what extent the zone of silicified porphyry, about 100 feet wide and nearly parallel with the upper adit, is actually 'ore'. The high-grade cross-

cut mentioned in our issue of January 17 does not, we are informed, represent an average cross-section of the lode, as it follows a cross-vein. This is true of other cross-cuts from the same adit. Examining engineers, please note! A series of diamond-drill holes is being started from the upper adit and from some of the cross-cuts, in order to ascertain the distribution of ore in a wide zone outside the enriching influence of the cross-veins. Two lower adits, at 250 and 710 feet respectively below the upper one, will be used for deeper exploration; these are now 400 and 550 feet long, respectively. The ore is silicious, being about 75% insoluble; it contains pyrite, galena, blende, and the various minerals of silver, including the native metal, but ruby silver is characteristic.

A Fall in Exchange

"Well, I guess we can get \$30 for our gold in London, now that it has gone to a premium of 50%." Such was a remark we overheard during the past week. On February 4 the price of gold in London was 129 shillings, which represents 55% above normal. Our Californian gold miner was wrong, of course, in supposing that he could get the benefit of the premium in London, because he would receive 129 shillings, not 30 dollars, and 129 shillings on February 3 was worth only \$20.65, which is pretty close to the standard value (\$20.67) of pure gold in New York; in other words, the market value of gold in London had risen as much as sterling exchange had fallen. On the same day silver was quoted at 88½ pence per ounce on Lombard Street while it brought 132½ cents on Wall Street. Formerly we used to multiply the London price, in pence, by two in order to get the equivalent in cents; now we have to do a different and less easy sum in arithmetic. The 88½ pence was the equivalent, at the current rate of exchange, not of 177 cents, but of 122 cents, which simply goes to prove that the price of silver as fixed in New York is largely artificial. On February 7 silver was quoted at \$1.32½ in New York, while it sold for \$1.35½ in San Francisco. On the same date it reached 89 pence in London, which at the exchange rate of \$3.32½ for the pound, was equivalent to only \$1.23½. However, the prices paid for the precious metals was not the most significant phase of the collapse in international exchange. On February 3 the pound suffered a depreciation, as compared with the pre-war rate, of 33%; on that day French, Belgian, and Italian exchange showed a fall ranging from 68 to 77% as against normal ante-bellum days. It was a débâcle. Some thoughtless persons seemed to think it amusing and regarded it chiefly as a compliment to the dollar. The drop in quotations on Wall Street and the semi-panic on the European exchanges served more correctly to reflect the seriousness of the crisis. Its meaning was understood; there it meant a heavy embargo on importation, here it meant a corresponding penalty on exportation. Only a fool would derive any sort of amusement from a condition that threatened to prevent him from trading with his own customers. The suggestion that the British purchase of American cotton might be stopped was taken by sundry yellow journals as a threat

to an American industry, whereas, of course, it was a legitimate and logical consequence of the prohibitive rate of exchange. Cotton is not the only trade that is menaced; it is merely an example. We have been doing an export business of three to four billion dollars per annum; during the War, and since, our surplus of exports has been stupendous; we have had an opportunity of supplying raw material and manufactures to the war-devastated countries, which needed both, because of their own inability to produce either of them or to obtain them anywhere except from our country. The drain on credit has been excessive; our customers have sent all their available gold to us long ago; they can only pay in goods or in credit; owing to the destruction of plants and the disorganization of industry they cannot send us their products as fast as they import ours; their credit facilities have been undermined by an excessive issue of paper currency; they cannot do business with us unless some restoration of international credit is effected; the fall in exchange, especially in the countries of continental Europe, merely reflects the natural consequences of the wastage and destruction of life, property, and industry since August 1914. Our foreign trade normally is small as compared with our domestic trade, but it is important because it serves as a means of disposing of our surplus; it is a safety-valve regulating the pressure of business; it is a flexible element in our national commerce. Prices at home in large measure are regulated by the intensity of exportation abroad. During the War we exported enormously; we have been living in a fool's paradise, for it is a condition that cannot continue, as the recent break in exchange indicates with a bang. One immediate result will be beneficial; we shall see a radical check on profiteering; prices of staple commodities will fall; H. C. L. will cease to be ominous initials; a surplus of domestic products will be accumulated by reason of a restriction on export; the laws of supply and demand will assert themselves, and the era of rising prices will come to an end. The fall in exchange will do more than the Attorney-General or the Housewives Association to end the orgy of profiteering and extravagance. 'Tis an ill wind that blows nobody good. Meanwhile we may learn another lesson. Chinese walls are out of date. We do not live upon an island in the middle of a lonesome sea. We are part of the comity of nations. No business-man can prosper if his customers cannot pay; if Europe goes bankrupt, we go bankrupt also; that is inevitable. All the world is in the same boat, and it is dangerous to all if anybody rocks it, especially in a rough sea.

The Licensing of Engineers

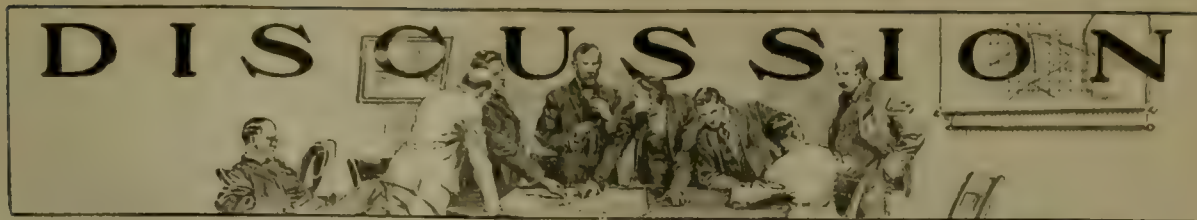
After 14 months of work, the committee of Engineering Council entrusted with the framing of a model law for the licensing of engineers, architects, and land surveyors, has completed its report. Copies of it have been distributed to the various engineering societies and technical journals. The report describes the methods used in conducting the investigation and then gives the text of the "recommended uniform registration law, to regu-

late the practice of professional engineering, architecture, and land-surveying". It is intended to give as wide publicity as possible to the text of this proposed law, so that the members of the professions affected may be informed, and, what is equally important, may have an opportunity for discussion. Engineering Council has as yet taken no action on the merits of the question, but expects to do so at its meeting during the current month, when it hopes to receive expressions of opinion, in order that it may be guided as to what action to take. The object of the report, however, is not merely to provide a subject for academic debate, although debate is essential, but to take the first step toward meeting a condition that has arisen. Various States already have enacted laws for licensing or registering engineers, and the general interest in the subject is certain to induce legislation in others at the next session of their legislatures. Moreover, the American Institute of Architects has proposed a model law that is so restrictive of other branches of engineering that unless engineers become sufficiently interested to investigate the matter thoroughly and make their combined opinion felt, they are likely in the near future to find their activities curtailed to an awkward degree. An example of this may be seen in Illinois, where a law for licensing architects was passed several years ago and enforced rigidly. The law was so much in favor of architects, to the exclusion of other engineers, that bitter feeling was engendered, and it was found necessary for the engineers to combine in obtaining the passage of a Structural Engineers' License Law. Illinois, therefore, has two laws to regulate the design and erection of structures, one for architects and one for other engineers. As an example of the endless confusion that would follow a different law for each State, and different laws within the same State, it need only be noted that under the model law proposed by the American Institute of Architects it would be unlawful for any but an architect to design or supervise the erection of a bridge, or any structure consisting simply of foundations and girders.

The time has come for engineers to act together in self-protection and to promote uniformity of regulations; for laws regulating the practice of engineering are being passed, and will continue to be passed, whether engineers co-operate in framing them or not. On other pages of this issue we publish the text of the bill drafted by Engineering Council. A board of registration is to be created for each State, consisting of seven members appointed by the Governor. This board passes upon applications for licenses. Certain facts, in the absence of disqualifying evidence, are accepted as *prima facie* evidence that the applicant is fully qualified to receive a license: for example, ten or more years active practice; or graduation, after a four-year course, from an approved technical school, plus four years of active practice; or, full membership in one of the national societies, such as the American Institute of Mining and Metallurgical Engineers. In case the applicant cannot qualify on any of these grounds, provision is made for the presenting of further evidence, which may include an examination, al-

though it is not expected that many applicants will be subjected to any such examination. In regard to the qualifications required, the report includes the following explanatory note: "The standard of qualification is set high for two reasons: The public welfare will be better promoted by maturer competency, and the prestige attaching to the term 'registered' will be more significant for the professional men themselves. In requiring the younger, less experienced men to serve somewhat longer as assistants or understudies to older men, no hardship is imposed which will not be compensated by the fuller return in recognition when registration is achieved." This seems reasonable. Other parts of the report deal with revocation and renewal of licenses, penalties for practising illegally, and privileges of a registered engineer in States in which he is not registered. Considerable attention is paid to the relation of architecture to other branches of engineering, in an attempt to harmonize the two and obviate the attempts to have legislation enacted that will be unduly restrictive of one branch at the expense of the other. The different branches of modern engineering interlock, and this attitude seems to us a wise one, worthy of reciprocity on the part of the architects, for example. The entire report appears to be carefully considered, and we hope that engineers will give it the attention that it deserves. Here we may record the fact that the mining engineers of Colorado, and also those of British Columbia, made a protest against any system of registration that placed a hindrance upon the examination of mines in a State or Province by engineers from other States or Provinces. This evidence of professional solidarity does credit to our friends in the two great mining regions mentioned, and we have no doubt that engineers in other parts of the United States and Canada will show a similar good-will.

Another interesting feature, arising from the action taken by Engineering Council, is the recognition of the fact that in Engineering Council we have at last an organization well fitted to represent the whole engineering profession in matters of general importance. On January 23 the governing bodies of the national engineering societies met in New York, at the Engineering Societies Building, and on that occasion it was agreed to recommend to each founder society that the amount contributed by each of them for Engineering Council shall be increased from \$3000 per annum to \$5000. It was also resolved that an appeal be made for a contribution of \$2 from every member—except juniors and students—of the five national engineering societies, for the purpose of supporting the welfare work for engineers. A meeting is to be called soon of representatives of national, local, state, and regional engineering organizations for the purpose of creating a comprehensive organization of the engineering profession. This is an epoch-making departure and bears the promise of great things. It sets the mark of approval on the work already done by Engineering Council and indicates the general desire on the part of the various branches of the profession to get together for their own good and for the good of the nation.



De-Gassing Cyanide Solutions

The Editor:

Sir—Referring to the letter appearing on page 38 of your issue of January 10, written, it is alleged, for the purpose of preventing “the uninitiated from kidding himself into the belief that the benefits of the Crowe process are obtainable by the arrangements described by” myself, in your issue of September 20, 1919, page 392, the inference being that a given vacuum, say, 15 inches, maintained in a de-gassing tank, such as I described and illustrated, will not remove entrained, occluded, or dissolved oxygen from cyanide solutions if said tank is connected with a submerged vacuum-filter: I have emphatically stated it will remove oxygen together with other gases, and that statement is apodictic.

I have nothing to sell or to advertise in this matter, and, needless to say, disclaim any intention or desire to wrong or mislead anyone, but feeling that better results have been attained and can be uniformly obtained by the old and well-known apparatus described, I have made it known in the best interest of the profession. I fully realize others have been using similar dry-vacuum apparatus for many years not differing in kind but only in degree, particularly regarding the capacity of de-gassing tanks. Those who have large storage in such tanks are to be congratulated; and those who have not, know the remedy. They can either enlarge vacuum-storage capacity, following the best practice in fully utilizing standard milling apparatus, or adopt the patent ‘chicken fixins’, pay tribute to monopoly, and bear testimony to the saving made in zinc and cyanide.

I join issue directly with Mr. Colbath on the utility and efficiency of the de-gassing apparatus used in Stratton’s Independence mill; in fact, there is only one better method I know of, the submerged vacuum-filter used as a clarifier, an apparatus in common use throughout the world these many years.

The submerged vacuum-filter is somewhat irregular in solutions discharged to the de-gassing tank, the maximum flow being coincident with the commencement of the formation of the filter-cakes and that maximum solution-flow usually contains the minimum amount of gases. The opposite condition, minimum flow of solution and maximum amount of gases, occurs when the formed cakes are exposed to the atmosphere during the filtration cycle; so we find a happy balance in favor of the combined filter and de-gassing apparatus, provided the tank is of ample capacity to cover the double object: exposing the necessary solution surface for de-gassing and providing stor-

age for the irregular flow of solution from the filter.

Clarification of some sort is invariably required before precipitation, and there is no better clarifier than the submerged vacuum-filter equipped with a de-gassing tank, as previously described. No matter what form of primary filtration has been used—vacuum, pressure, or gravity—the filtrate from all or each is best clarified in the submerged vacuum-filter and the clear solution pumped to the precipitators direct from its de-gasser. One has not far to look for such an operative arrangement; I have seen designs along similar lines extending back many years, that is to say, a submerged vacuum-filter for treating slime, the filtrate from which was clarified in a similar, but very much smaller, submerged vacuum-filter and pumped direct from the de-gasser to the precipitators, both de-gassing tanks and filters operated from one dry-vacuum pump.

The instantaneous oxidation of cyanide solutions should not be taken seriously—it will not by the experienced operator; there has been far too much written about it; so far we have no authentic account of spontaneous combustion of cyanide solutions, and writers should be careful not to increase fire-rates on the milling-plants of the country; they are already far too high.

Los Angeles, January 30.

PHILIP ARGALL.

The Crowe Process

The Editor:

Sir—Now appears James S. Colbath, all the way from El Paso, with an effusion, printed in your issue of January 10. Allow me to suggest that Mr. Colbath, and the other advocates of the claims of Mr. Crowe, get together and present to him a fitting testimonial for his alleged discovery of a property of an assemblage of well-known materials, whose properties were well known before, and his putting the same to use by means of long-practised and well-known methods and apparatus, which effected the same purpose and end as always before.

Let the testimonial be a leather medal, or one of greater value, even up to a granite monument on top of Pike’s Peak, overlooking the site of the great discovery. I am tempted to offer the medal myself.

I started the attack on the Crowe patent—note the distinction between ‘patent’ and ‘process’—for two reasons: One was because I desired to inform and protect the gold-metallurgist from unnecessary payments for the alleged right to use a useful process under the claimed protection of an illegal patent. The other was to set forth an illus-

tration of the deplorable inefficiency of the U. S. Patent Office.

Immediately I was answered by assertions that the alleged discovery by Mr. Crowe was a great advance in cyanide metallurgy of gold; and, by implication only, that the patent is a legitimate one. Let us further examine as to that:

The U. S. patent law states: "A patent may be obtained by any person who invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application."

Thus any patent existing on grounds other than here stated, or through fraud or error, is illegal and void.

Preliminary to an invention there must have been a discovery. A discovery of a principle, as such, is not patentable. But new means and new methods of utilizing such a discovery are patentable as apparatus and processes. Appreciation of the potential value of a discovery may show a talent for progression, and if published to the profession, or artizan, may be of much benefit in the way of foundation for invention. Such publicity is not patentable.

It is acknowledged by Mr. Colbath and the like thinkers that the principle of the alleged Crowe process was long known. Nowhere in the Crowe patent is there a claim of the discovery of the principle. That is not set forth in any of the 31 claims as his invention. All patents are finally construed by the courts according to the virtues of their claims, as defined by the prior state of the arts to which they are related, and the statements made in the application by the patentee.

Mr. Crowe does not set forth in his patent any actually new or original means or method—apparatus or process—for applying to the art of cyanidation the discovery of the principle that the absence of air or other gases is essential to good precipitation of the metals. But he does attempt to appropriate as his invention, in 31 ingeniously worded claims, the methods and apparatus long in use prior to the date of his application for the patent; shown by me in at least four instances cited by me in my previous letters on the subject. And especially in the letter so ably written by Mr. Argall, and which Mr. Colbath attempts to answer.

I am not going to try to answer the rot Mr. Colbath writes about Mr. Argall's experience and apparatus. Mr. Argall is quite able to defend his position, and I believe able to tell even further things still more damaging. He may do so if he happens to think that the "game is worth the candle".

Contrary to Mr. Colbath's statement, cyanide solution has no marked avidity for the absorption of air. While it gives up its absorbed air very rapidly under the influence of a vacuum, to re-aerate it takes much time unless air be forced into it by agitation and pressure. It is absolutely erroneous to assume that de-aerified cyanide

solutions re-absorb air almost instantly under atmospheric pressure.

The conveying of such solutions through pipes out of external air contact is about as old as any of the other of the elements of the combinations set forth in the claims of the patent. Those claimed as new, being identical with the old apparatus and methods so unreservedly appropriated, work now as then and worked then as now. Whether the inevitable results were premeditated is entirely immaterial in relation to patentability.

Credit for setting forth, prominently, the virtues of de-aeration of cyanide solutions may be accorded to Mr. Crowe. The discredit of granting a patent therefore rests with the U. S. Patent Office. Gullibility may be laid at the doors of . . . never mind! Let it go!

Philadelphia, January 20.

N. S. KEITH.

[A reply to the criticisms of the validity of the Crowe patent appeared on pages 14 and 15 of the advertising section of our issue of January 31. Any reader interested in the controversy is advised to read the reply made there by Mr. Charles W. Merrill. We do not care to publish any further letters on the subject, which has now been adequately ventilated.—EDITOR.]

Engineering Employment Bureaus

The Editor:

Sir—The statement of Mr. Bradley Stoughton made in San Francisco and quoted in editorial in your issue of January 3, which applies to the employment work of the founder societies and of A. A. E., calls for correction, for it is inaccurate. The figures that are of interest to engineers are not the men put in touch with positions open, but the number of men actually placed and the cost per placement. In the three months period referred to by Mr. Stoughton, the American Association of Engineers placed 389 men at a cost of approximately five dollars per placement, while the founder societies employment bureau placed 375 men at a cost of about ten dollars per placement. In the interest of accuracy, these facts should be set before your readers.

C. E. DRAYER,
Secretary.

Chicago, January 20.

THE DOMESTIC production of arsenic in 1919, according to estimates compiled by James M. Hill, of the U. S. Geological Survey, was 5900 tons, as compared with 6400 tons 1918. The imports of arsenic for the first nine months of 1919, as reported by the Bureau of Foreign and Domestic Commerce, were 1389 tons. The imports for the year will probably amount to about 1550 tons. Most of the imported arsenic came from Canada and Mexico, though some came from Belgium and Japan. The quantity of arsenic available for consumption in 1919 was 7450 tons, as compared with 7170 tons in 1918. There were no exports either of foreign or domestic arsenic during the first nine months of 1919. Two domestic companies who produced considerable arsenic in 1918 reported to the Geological Survey that they produced none in 1919 on account of low prices.

Some Ideas on Ball-Mill Practice

By CURTIS LINDLEY, Jr.

The suggestions in this article are submitted as an explanation for many peculiar results obtained in the practice of crushing with balls, pebbles, or bars. It may be that the ideas set forth herein are not new, but I have not been able to find a similar expression of opinion in any of the published studies of the subject. My hope is that these suggestions will be of some benefit in solving sundry problems connected with ball-milling.

The first suggestion is based on a probable law for this type of crushing. For instance, we know that we feed material to a ball-mill and obtain finer material therefrom. We do not absolutely know that any particular particle in the feed will be crushed on passing through the mill. In other words, it is possible in a closed circuit for a particular particle to circulate indefinitely. However, this is not probable. In this last statement there is perhaps a clue to the law governing this kind of crushing. The law is that of probability and chance, which is governed by definite formulas. Stated simply, the greater number of chances given for any particle of feed in its passage through a mill, to be acted upon by a force sufficient to crush it, the greater will be the probability of it being crushed.

Let us see how this applies to the operation of these types of crushing-machines. In the comparison of pebble and ball-pebble mills, if we consider both mills to be of the same size, the ball-pebble mill will have the greater capacity, owing to the fact that a greater number of crushing-units can be contained in the critical ball or pebble-volume of the mill, thereby giving a greater number of chances for each particle of feed to be acted upon by a force sufficient to crush it.

Considering the ratio of solid to liquid, an increase in the liquid content causes a more mobile mixture in which the solid particles have greater freedom of action and therefore fewer chances of being caught between the balls when in contact. As a further explanation of this point, two balls approaching a contact in a liquid set up currents of increasing velocity within the liquid. These currents tend to move away from the point of contact and in this way remove particles to be crushed from the crushing-area between the two balls. In a thick pulp the particles are hindered in their movement and certain ones remain in the proper place to receive a blow. The thicker the pulp, the greater the chance for crushing. Aside from the above described action, the solid-to-water ratio can be brought out in another way: Consider two different consistencies (by weight) of pulp, one with 30% moisture and one with 50% moisture. There is 70% (by volume) more solid in the former pulp than in the latter. In addition to the effect of hindrance of action of the particles, the thicker pulp, in this case, allows each indi-

vidual crushing-force a 70% greater chance to act upon a particle of solid than in the thinner pulp. Disregarding the greater freedom of action of the particles in a thinner pulp, there is an apparent fallacy here, in that the thicker pulp will provide a greater number of solid particles per unit-volume to be acted upon by a given number of unit-crushing forces than the thinner pulp, and therefore there would be less crushing done. The conclusion drawn from this is that there are two groups of chances to be considered; the first group includes the chances that each unit-crushing force is given to act upon solid particles, and the second group is the chances each particle of solid is given to be acted upon by a unit-crushing force. The first group can be more readily understood by a comparison of shooting at one or a flock of ducks, and the second group by a comparison of shooting at one duck with a rifle or a shot-gun.

The mill that offers the maximum number of chances in each group will have the greatest crushing-capacity.

The second suggestion developed from a study of the first suggestion by a few rough computations; it is probably quite different from the general line of theory heretofore offered by authorities on the subject as an explanation of the crushing action in ball, pebble, and bar mills.

From a careful study of the literature of the subject, I find a general consensus of opinion that the greatest amount of crushing done by these mills is accomplished by direct impact of the falling balls upon the material to be crushed, and that only a slight amount is done by attrition.

The suggestion offered is that only a slight amount of crushing is done by direct impact and a less amount by attrition. The principal crushing action, however, is that of transference of crushing force through that portion of the ball mass at rest or nearly so, this action being initiated by the impact of the falling balls. Each ball in the mass at rest, or nearly so, is capable of coming into contact with from three to twelve other balls at the same time. Let us consider any stack of balls in this mass, like the common stack of cannon-balls. Consider it to be five balls high with one ball at the top, four balls in the next lower tier, nine balls in the next lower tier, 16 balls in the next, and 25 balls in the bottom tier. There are, in all, 200 points of contact in this stack. This, of course, is an ideal arrangement considering truly spherical balls of the same size, but it will explain the idea quite thoroughly. Of the 200 contacts, 120 are in direct compression from the weight of the balls above, and 80 are merely lateral contacts having no initial stress. Besides these there would be 25 more contacts between the 25 balls in the bottom tier and the medium supporting them. This would give 145 points of contact under direct compres-

sion. Consider that this stack of balls took position in a pulp of 30% moisture. The volume of solid in this pulp would be about 50% of the total, and the probability would be that one-half the points of contact would hold solid particles in place when the balls came to position. The possibility of a particle of solid matter coming to rest on the top of the top ball is quite remote. Now, suppose a ball of the same weight as those in the stack is dropped from a height of five or six feet and falls directly on the vertical axis of the top ball. There would be no crushing by direct impact, but there would be 73 particles held rigidly, as in so many vises, ready to receive a force transferred through the stacked balls. This does not consider the particles at their points of lateral contact. The number of particles that would receive a force sufficient to crush them would depend upon many factors, but it is easily seen that the greatest amount of crushing is done in this way.

In attacking the problem of this type of crushing through the law of probability and chance, I was unable, by reasonable assumptions, to arrive at a figure that would substantiate the theory of direct impact crushing. There were never enough direct impacts to account for more than about 5% of the work done, hence the development of the idea of transference of forces.

It is hoped that these suggestions will prove useful. From a careful study of them, it seems quite probable that a direct comparison of all types of ball, pebble, and bar mills can be made. That the mathematics of the law of probability and chance can be applied to any great extent is questioned, but an observance of the simple rules, either consciously or unconsciously, is imperative for obtaining the best results.

THE supply of rock phosphate in England, both for the manufacture of super-phosphate and for us in the form of ground phosphate is reported to be far below the requirements. As evidence of this, it is pointed out that imports are over 100,000 tons behind the war standard of 1918. The imports of rock phosphate in September 1919 were only 22,423 tons, compared to 29,000 tons in September 1918, and 36,500 tons in September 1917. Imports for the first nine months of 1919 were 260,000 tons, or over 100,000 tons below that for 1918. It is feared by some English manufacturers of superphosphate that there may be a world shortage of phosphate. They point to the shortage of phosphate fertilizers in South Africa which has prevailed for nearly three years, as further evidence upon this point. Steps are being taken there to utilize more fully the Saldanha Bay phosphate deposits. The difficulty of getting phosphate rock has been acute for some time due to reduced output in North Africa, from which source England has drawn much of her supply, together with the fact that France has been retaining more for her own use. Another cause is the shortage of transportation facilities from our own Florida field, as well as from the fact that there has been a dearth in production in this domestic field.—U. S. Bureau of Mines.

'Panel' Stopes in South Africa

The large areas of payable ground encountered on the Government Gold Mining Areas have emphasized the necessity for evolving some method of stoping which will permit the extraction of the ground without unnecessary danger and expense due to collapse of the worked-out areas and consequent closing of main haulage-ways. It is well known that on practically every deep-level mine that is engaged in working out boundary stopes, the drifts connecting these stopes with the shaft, and which pass through worked-out areas, are only kept open at great expense and are the cause of frequent accidents. The obvious method of procedure should be to attack boundary stopes first and work toward the shaft instead of from the shaft, as is the present practice. This has been frequently advocated, and is recommended by textbooks, but unfortunately has never been tried here.

At the Government Gold Mining Areas one of the most extensive blocks is being attacked in the following manner: Raises are driven from the main drift in pairs, with a width of 100 ft. in the face and 300 ft. apart, ventilation being forced up along a brattice. When these raises reach a length of 300 ft. they are connected by headings 100 ft. wide. Doors are then erected in the drift below, which forces the ventilation current through the deviation thus provided. The raises are then continued for another 300 ft. and the operation of connection repeated, when the previous connection is closed by a 'stopping'. This is continued as far as desired. When stoppings are required in the connections the sides are narrowed down to convenient widths to minimize the chances of leakage. The whole block is thus completely honeycombed and provided with countless points for future attack. The ground is also provided with strong panels, or pillars, which will ensure the rigidity of the block and make general movement impossible. When general stoping is commenced from the point farthest from the shaft, the usual 'packs' will be sufficient to protect the working faces. An important consideration is the fact that a sufficient tonnage is ensured by the width of the headings, the number of which can be increased as desired. The present machine efficiency in the headings is excellent. Broken rock will be handled by tracks and winches.

At the New Modderfontein and Modderfontein 'B', panel stoping has been in progress for some months, with the same object in view, but the methods employed are not the same. Raises are put through in the usual manner from level to level, and stopes are then set off simultaneously at measured intervals, with a length of face of 90 ft., leaving panels of 30 ft. between. The stopes are advanced on lines, and connections are put through the panels for ventilation as required. Broken rock is handled with the aid of foot-wall cross-cuts and stope tracks with ore-chutes where required. It is probable that one or the other of the above schemes will be adopted on other large mines of the district. The advantages are so apparent that, where ore-reserves permit, it is the obvious thing to do.

The Cottrell Process in Japan

By RITARO HIROTA and KYOSHI SHIGA

The history of the Cottrell process of electric precipitation in Japan begins with the purchasing of the Cottrell patent-rights in 1916 by T. Wada, representing seven principal mine-owners in Japan, from the International Precipitation Co. of Los Angeles, California, of which Walter A. Schmidt is president. Prior to this, negotiations were opened between Mr. Wada and the International Precipitation Co., through H. W. Paul, the company's agent for Japan.

An experimental precipitator consisting of 16 pipes of 12 in. diameter and 16 ft. long, with a capacity of 3000 cu. ft. of smoke per minute at a velocity of 4 ft. per second, was erected in the compound of the Ashio smelter by the Metallurgical Research Institute, Tokyo, of which Mr. Wada is the president.

This experimental treater with the electrical equipment was erected according to the design and suggestions of the International Precipitation Co. in October 1916. The tests were conducted by the engineers of the Metallurgical Research Institute, assisted by F. B. Church and K. I. Marshall, engineers of the International company, who were in Japan at that time in connection with the treater installation of the Asano cement factory at Tokyo. The plant proved satisfactory, treating the mixed gases coming from the roasting-pots, blast-furnaces, and converters of the copper-smelter and precipitating the dust containing oxides of arsenic, zinc, and lead, as well as a small amount of copper.

Among mines and smelters, the Ashio copper smelter of the Furukawa Mining Co. was the first to apply the results of these tests.

The Asano Portland Cement Co., of Tokyo, was having considerable trouble with residents in the vicinity of the plant, because of the dust nuisance. If this nuisance had not been abated by December 25, 1917, the Asano company would have been obliged to move this plant to some other locality. Confronted with this difficulty, and learning of the successful results obtained at the plant of the Riverside Portland Cement Co., the Asano company decided to adopt the Cottrell process at its factory. As the time-limit was definite, they proceeded immediately to build the plant. Before the patent-rights were legally

transferred to Mr. Wada of the Metallurgical Research Institute, the Asano company negotiated with the International Precipitation Co. for the use of the Cottrell process in its Tokyo factory. F. B. Church and K. I. Marshall were sent from the Los Angeles office to look after the design, erection, and operation of the plant.

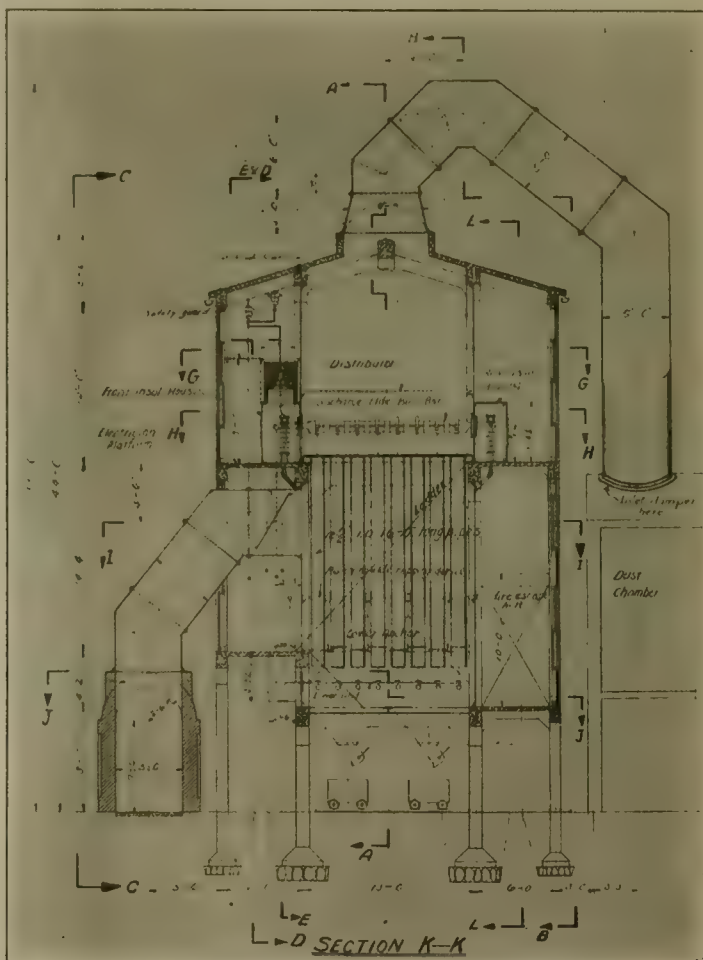


FIG. 1. SECTIONAL ELEVATION OF IKUNO TREATER

Their effective efforts benefited not only the Asano cement factory, but also the community in general, as the Cottrell plant, starting a few days before the specified time, caught more than 95% of the dust causing the nuisance.

The introduction of the Cottrell process was made a part of the business undertaken by the Metallurgical Research Institute, where general metallurgical re-

searches are made by competent engineers and scientists. Special attention is paid to the SO_2 gas and dust problems, as well as to different subjects in ore-dressing.

To perfect designs of Cottrell installations for prospective customers and to study the actual operation of Cottrell installations in the United States, the Metallurgical Research Institute sent Mr. Shiga to the International company at Los Angeles, where he studied the design and operation of precipitators. In May 1917, after completing his study, Mr. Shiga was joined by Dr. Hirota, manager of the electrical precipitation department of the Metallurgical Research Institute, and together they visited the principal smelters and factories in the United States in which the process has been installed, including the plants at Miami, Garfield, Tooele, Anaconda, Riverside, Hagerstown, the Duquesne Reduction works, the Pennsylvania Smelting Co., the Portland Gas works, and the Merrimac Chemical Company.

In the meantime orders were placed with the Westinghouse and General Electric companies, and the Kelman Electric Co. of Los Angeles, for electrical equipment, such as extra-high-tension transformers, motor-generators, and rectifiers. Orders were also placed with the Western Pipe & Steel Co. of San Francisco, and the Robertson Bros. Co. of Chicago, for pipe-electrodes, to be used in treater installations at the smelters belonging to the Mitsui and Mitsubishi companies.

Since the return of Dr. Hirota and Mr. Shiga to Japan in the fall of 1917, several plants have been equipped with Cottrell installations, and with the aid of the engineers of the Metallurgical Research Institute, these plants are now working satisfactorily, eliminating the smoke and dust nuisance, and collecting many tons of valuable dust, which was hitherto going to waste.

The Research Institute did not lose the opportunity of making the Cottrell process widely known, and it has exhibited a model installation at the expositions in Tokyo and Osaka. Lectures have been delivered by Dr. Hirota at the meetings of the Mining Engineers, Mechanical Engineers, and Railway Association, and by Mr. Shiga before the Chemical Industrial Association, and the Smoke Abatement Association of Osaka City.

Thus the Cottrell process, although only a few years old in this country, has made comparatively rapid progress. Eight treaters, having a total of 1984 pipes, have been built and are now operating. However, on account of war conditions, there has been considerable difficulty in procuring electrical equipment, pipes, and other material. This has hindered development of the process. Engineers and metallurgists in Japan are eagerly investigating it, and several companies now intend to install precipitators for collecting sulphuric acid fumes coming from acid-boiling kettles and acid-concentrating furnaces; for cleaning iron blast-furnace gases used for firing boilers and hot stoves; and for collecting sulphuric acid liberated from alunite calcination furnaces. The Research Institute has already submitted designs and specifications to the Imperial Mint, Shikama alum factory, Kanto Sanso alkali works, Hokkaido Iron & Steel

works, and the Fujita Mining Co.'s plant. The Imperial Mint has quite recently decided to install a plant for collecting sulphuric-acid fume from acid-boiling kettles. It is clear that this process, developed in the United States during the past decade by Dr. F. G. Cottrell, is already being adopted quite extensively in this part of the world.

The following are brief descriptions of the electrical precipitators installed in Japan up to the present time:

ASHIO SMELTER, FURUKAWA MINING Co. There were two treaters installed in 1918; one, the 'main treater', was intended to treat the mixed gases from four McDougall roasters, two blast-furnaces, and four converters of the copper-smelter; and the other, called the 'reverberatory treater', was intended to treat the gases from a reverberatory furnace that had passed through waste-heat boilers. Each treater is furnished with an independent power-plant. Six electric units are being used for the main treater, one unit being spare, and two are used for the reverberatory treater. Each electric unit consists of the following General Electric equipment: one 10-kva., 50-cycle, single-phase, 200 to 100,000-volt transformer; one 10-kva., 200-volt, 50-cycle, single-phase alternator driven by a 15-hp., 50-cycle, 500-volt, three-phase induction motor; and a disc rectifier, manufactured by the Kelman Electric Co., directly coupled to the motor-generator shaft. Besides these machines, exciter sets for the excitation of the field of the two alternators are furnished, two for the main treater and two for the reverberatory treater. The charging voltage is adjusted by regulating the intensity of the field current of the alternators. By this means, it is possible to produce practically any desired voltage at the secondary terminals of the transformer.

The main treater consists of ten sections, each containing 64 riveted pipes, arranged in a square, making a total of 640 pipes; while the reverberatory treater consists of three similar sections, or a total of 192 pipes. These pipes, 12 in. inside diameter and 16 ft. long, of No. 16 sheet-steel, were manufactured by the Western Pipe & Steel Co. The gases are drawn through the main treater by two induced-draft fans, and are discharged directly from the fan-casings, while those of the reverberatory furnace are drawn through the reverberatory treater by the natural draft in the stack. As the reverberatory furnace is not operating continuously at present, the gases from eleven pot-roasters, four blast-furnaces, and four copper converters are mixed and treated by the main treater. Thus the volume of gas now handled by the main treater is probably somewhat in excess of 150,000 cu. ft. per minute, for which it was designed. The amount of dust collected varies from six to ten long tons per 24 hours. The efficiency of precipitation seems to depend upon the nature of the furnace-charge and the moisture and temperature of the gases treated. When the conditions are favorable, it runs as high as 98%; sometimes it drops to about 70%. When the conditions are such that the charging voltage can be raised above 80,000 volts with a comparatively small increase in the

current, the results are good. Actual experience at the smelter has shown that when the smoke has a white appearance, precipitation is satisfactory. On the contrary, when the smoke coming from the treater-outlet has a yellowish appearance, the efficiency of precipitation is not so high and the current increases greatly if the operator tries to raise the charging voltage. The smelter engineers are now investigating this phenomenon, and hope soon to get entirely satisfactory precipitation, regardless of the different smoke conditions. The average power consumed by the precipitator is about 30 kilowatts.

Cu	1.37	Al ₂ O ₃	1.45
Pb	2.00	As	31.81
S	10.72	Pb	0.84
SiO ₂	3.02	Zn	5.57
CaO	1.10	Moisture	0.40

Thus the electrical precipitator collects not only the poisonous dust, such as arsenious oxide, but also the fine particles that hitherto were escaping into the atmosphere, and that perhaps were acting as nuclei for the concentration of noxious gases, such as SO₂, preventing their free diffusion. Such poisonous dust and concentrated noxious gases cause damage to vegetal growth. The



FIG. 2. ASHIO PLANT, TREATER NOT IN OPERATION



FIG. 3. ASHIO PLANT, TREATER IN OPERATION

Several years ago a large dust-chamber was built, using the Roosing wire system. The gases passed from this chamber to four large stacks, in which they were diluted by the forced admission of fresh air, before being discharged into the atmosphere. The main treater was installed at the side of this dust-chamber, so the gases pass through the chamber, before going through the treater. The numerous suspended wires in the chamber were removed, so that only the heavier dust, which is of more value because of its higher percentage of metals, would be caught; and all the lighter dust, which cannot be efficiently collected by gravity settling, would be arrested in the Cottrell treater.

An analysis of one sample of the precipitate from the Ashio main treater follows:

smoke nuisance has, therefore, been greatly reduced by the Cottrell installation.

As the analysis shows, the precipitated dust contains rather large quantities of the oxides of arsenic. These oxides are extracted by subliming the dust in a small reverberatory furnace. The resulting cinders, rich in copper, are sent back to the pot-roasters after being briquetted.

KAMIOKA SMELTER, MITSUI MINING CO. This treater consists of three sections, each containing 64 riveted pipes arranged in a square, or a total of 192. It was installed and started in May 1918. The pipes, 12½ in. inside diameter by 16 ft. long, made of No. 14 gauge sheet-steel, were manufactured by the Western Pipe & Steel Co. The gases passing through the treater come

from the following furnaces: three lead blast-furnaces, two liquation furnaces, five softening furnaces, and all the lead-refining furnaces and kettles. At first it was intended to install a treater having four sections of the same size as those specified above, and three electric units. In fact, three 15-kva., 200 to 100,000-volt transformers, and three motor-generator sets were ordered from the Westinghouse company. On account of the delay in shipment of this electric equipment, due to labor troubles and difficulties of transportation caused by the War, the size of the treater was reduced and temporary electric machines were substituted until those from the Westinghouse company arrived. The Kamioka smelter is situated in the heart of the sericulture district, and the residents in the vicinity made strenuous objections and demanded heavy indemnities, claiming that the smoke damaged the mulberry leaves and killed the silkworms. Therefore, every effort was made to complete and start the Cottrell plant at an early date. The temporary machines, supplied by the Metallurgical Research Institute, consisted of high-tension transformers, the voltage of which was regulated by an induction regulator, and K-1 type rectifiers driven by synchronous motors. The precipitator worked continuously without trouble, and from 1 to 1.5 tons of dust per 24 hours was collected, even though the temporary electric equipment was being used. The Westinghouse equipment has since arrived and is now installed.

Analysis of the precipitate is as follows:

As	19.65	SO ₂	0.63
Pb	57.26	Zn	1.68
Cu	Trace	Ag	0.0063
Bi	0.16	Au	Trace
Fe	0.16	Insoluble residue	0.31
Total S	5.91	Moisture	0.90
Free S	1.13		

The voltage for charging the treater is about 70,000 volts and the consumption of power is approximately 6 kw. Not only has the Cottrell process settled the smoke nuisance, but it has also been the means of saving dust that is valuable to the smelter because of its high metallic content. Hence, this plant, although small in size, presents the most striking example of the benefits that have been derived from the process, both by the public and the smelters in Japan.

NAOSHIMA SMELTER, MITSUBISHI MINING Co. The erection of this smelter was permitted by the Government on the condition that the effluent gases would be cleaned by the Cottrell process. The operation of the treaters was therefore begun when the smelter started, in March 1919. The treater consists of five units, each containing 64 lock-seam pipes arranged in a square, or a total of 320. These pipes, manufactured by the Robertson Bros. Co., are 12½ in. inside diameter by 16 ft. long and are of No. 14 gauge sheet-steel. The treater was designed for a capacity of 80,000 cu. ft. per minute, assuming a velocity through the pipes of five feet per second. The lead-bearing fume from the smelting-furnaces and the fume from the McDougall roasters and the converters are mixed, and treated together in the precipitator. Natural draft is furnished by a stack 150 ft. high and 10 ft. inside

diameter. The electrical equipment consists of three Westinghouse units, similar to those described above for the Kamioka smelter. As the delivery of these machines was delayed, the plant was started using temporary machines, as at Kamioka.

The smelter having only recently been started, the furnaces are not yet running at their full capacity and the volume of gas handled runs from 40,000 to 45,000 cu. ft. per minute. The efficiency of precipitation is so high that practically no visible smoke issues from the stack and the people scarcely realize that such a large smelter is in operation.

The dust collected per 24 hours amounts to about 1.5 tons, and its analysis is as follows:

Cu	2.30	Au	Trace
Pb	22.54	Ag	100 gm/ton
Fe	11.20	Sb	3.14
S	12.00	Zn	3.29
As	13.43	Loss on heating	25.68

After much study and discussion, 64 pipes, arranged in a square, as designed for the Naoshima treater, were chosen as the standard treater unit by the Research Institute. For small plants, 32 pipes, arranged in a rectangle 8 by 4, or half the size of the standard unit, are used. This plan was adopted to facilitate the design and erection of plants, the object being to benefit by the standardization of parts. A sectional view of the Ikuno treater, which is very similar to the Naoshima treater, is given in Fig. 5.

IKUNO SMELTER, MITSUBISHI MINING Co. The treater at this smelter handles the gases from two blast-furnaces smelting copper ores. It consists of two sections, each having 64 lock-seam pipes, arranged in a square. These pipes are 12½ in. inside diameter and 16 ft. long, and are of No. 14 gauge sheet-steel. The gases, after passing through an old dust-chamber, are drawn through the treater by an exhaust-fan and are discharged from the old stack into the atmosphere. Two sets of electric equipment, one unit to be spare, and each consisting of a 15-kva., 200 to 100,000-volt, 60-cycle, single-phase transformer, and a motor-generator set, were ordered from the Westinghouse company. In January 1919 this treater was started, using temporary equipment. At the first trial, the treater showed good efficiency. This efficiency lasted only a couple of days, and then the operation became so unsatisfactory that the diminution of smoke could scarcely be recognized even when the treater was charged with high potential. After experimenting in various ways, it was decided to humidify the gases, a practice which was found necessary for satisfactory precipitation in several American plants. A dozen orchard spray-nozzles of ¼-in. diameter, arranged in the dust-chamber, using water at a pressure of 120 lb. per square inch, injected a fine spray into the gases before they entered the treater. Precipitation was conspicuously improved and the efficiency raised to about 95%. Now the operator can raise the charging voltage to 80,000 volts while the current is only approximately 30 amperes. When, in order to examine the effect upon precipitation, the water sprays are turned off, the charging potential



FIG. 5. ASHIO TREATER. TOP OF ELECTRODES.

drops and the current increases so that the efficiency becomes as low as 50%. This experiment shows that smelter smoke, difficult to precipitate on account of its non-conductive properties, is often easily treated after being humidified.

The amount of dust precipitated per 24 hours is about 0.6 of a ton, and its analysis is as follows:

	%		%
As	0.0007	Zn	6.80
Pb	7.80	CaO	0.30
Cu	0.50	MnO	Trace
Bi	2.48	SiO ₂	1.05
Sb	32.30	S	12.17
Sn	Trace	SO ₂	0.78
Fe	10.80	H ₂ O	5.40
Al ₂ O ₃	1.01	C, etc.	12.32
	0.20		

NIKKO ELECTROLYTIC COPPER REFINERY, FURUKAWA MINING Co. Here the gases from two cupellation and two reduction furnaces are treated to recover silver-bearing lead fumes. The treater consists of one section of 32 pipes, arranged in a rectangle 8 by 4. These pipes, manufactured by the Western Pipe & Steel Co., are 12½ in. inside diameter by 16 ft. long, and are of No. 14 gauge steel-plate. The treater was designed to handle a gas volume of 8200 cu. ft. per minute. The actual volume is about 6500 cu. ft. at a temperature of from 100° to 200°C., and is drawn through the treater by an exhaust-fan. The electric equipment consists of a 10-kva., 50-cycle, 200 to 100,000-volt transformer, manufactured



FIG. 6. ASHIO TREATER. BOTTOM OF ELECTRODES

by the American Transformer Co., and a rectifier of the rotary-arm type, 30 in. diameter, supplied by the Research Corporation in New York. The rectifier is driven by a 1½-hp., 220-volt, three-phase Westinghouse synchronous motor. The transformer has taps on the low-tension windings which will give voltages of 50,000 62,500, 75,000, 87,500, and 100,000 on the secondary. These taps, together with a small capacity rheostat in the transformer primary circuit, afford sufficient range in voltage.

The treater was started in May 1919. The analysis of the precipitated dust is as follows:

	%		%
Au	Ni	Pb	54.90
Ag	0.0896	Se	14.23
Cu	0.23		



FIG. 7. NIKKO COPPER REFINERY

The amount of the precipitate is about 100 lb. per 24 hours. The consumption of power is comparatively high, ranging between 2.5 and 5 kilowatts.

ASANO PORTLAND CEMENT Co. Two precipitators were installed at the Tokyo factory of the Asano Portland Cement Co. in 1917; one for the rotary kilns and the other for the lime-kilns. They consist respectively of three and two standard units. Both treaters are energized from a central power-house in which four electric units are situated. Each unit consists of a 200 to 75,000-volt, single-phase, high-tension transformer and a motor-generator-rectifier set. All this machinery, with the exception of the rectifiers, was manufactured by the Allis-Chalmers company. The rectifiers were built by the Kelman Electric Co. The three-phase induction-motor

of the motor-generator-rectifier set furnishes power to the single-phase generator and to the rectifier. Power for the primary circuit of the transformer is supplied by the single-phase generator. The high-tension transformer current is changed to a uni-directional current by the rectifier, and as such, is impressed upon the treater-electrodes. The treater-discharge electrodes, made of No. 14 iron wire, are charged with a uni-directional current of negative polarity.

The volume of gases handled by the rotary-kiln treater



FIG. 8. TRANSFORMER AND RECTIFIER

is about 70,000 cu. ft. per minute at a temperature of from 250° to 300°C. Eight to ten tons of semi-calcined cement dust is collected per 24 hr., the efficiency being about 95%. The lime-kiln treater handles 40,000 cu. ft. per minute at 80°C., and the efficiency is from 80% to 90%. The high-tension voltage used is from 50,000 to 60,000 volts and the total consumption of power is approximately 12 kilowatts.

The dust collected in the treater is very fine and dark gray in color. An analysis of one sample is as follows:

	%		%
Loss on ignition (including 2.75% of carbon)	7.13	K ₂ O	6.69
Moisture	0.37	Na ₂ O	1.83
SiO ₂	24.64	SO ₃	4.14
Fe ₂ O ₃	2.30	Cl	2.95
Al ₂ O ₃	9.10	Insoluble residue	4.64
CaO	34.66		
MgO	1.55		100.00

Mining and Milling Tin-Tungsten Ore in Tasmania

By WM. E. HITCHCOCK and J. R. POUND

*The S. and M. mine, which is the property of the S. and M. Syndicate, London, is situated at Moina, in north-west Tasmania, 18 miles from Staverston railway station and 36 miles from Devonport. In common with the inland districts of north-west Tasmania, the country facing from the high interior table-lands is much broken by deep river gorges, thus confining the main roads to the spurs between these gorges. Much of this district is covered with basalt, and, except when cleared, carries a dense growth of timber and scrub. In many places, however, various exposures of the mineral-bearing rocks are to be seen. Those in the vicinity of the S. and M. mine are granite, porphyry, quartzite, conglomerate, a lime-silicate rock (locally called garnet), and limestone.

GEOLOGY. The tin-tungsten lodes are a complex of veins traversing beds of sandstone or quartzite and lime-silicate rock. These rocks form a contact metamorphic aureole surrounding a mass of granite and granite-porphyry which is exposed further east and south for a width of between two and three miles, and for about a mile from north to south. This exposure of granite represents one of the many uprisings of acid magma which occurred in different parts of Tasmania during the Devonian period. The occurrence of the lime-silicate rock at the S. and M. mine points to the alteration of original limestone within the zone of contact-metamorphism. The rock consists of magnetite, fluorite, garnet, and vesuvianite, with epidote and veins of pink feldspar. The contact-metamorphic minerals are, on the other hand, absent from the mineral lodes in this rock. The lode gangue consists mainly of quartz, topaz, fluorite, and mica. Its structure is pegmatitic, and the tin, tungsten, bismuth, and molybdenum ores are pneumatolytic in nature and origin. The economic minerals at Moina may be considered as having had their source in the granite magma. The pegmatitic veins both in the granite and the surrounding aureole harbor ores of tin, tungsten, bismuth, and molybdenum, indicating deposition from metal-bearing igneous emanations. At a greater distance from the granite boundaries the metallic vapors were replaced by magmatic waters in an outer hydrotogenic zone, giving rise to the deposition of galena and zinc-blende—for example, at Wilmot River, Lea River, Five-Mile Rise, etc.

THE MINE. At the S. and M. mine five lodes are worked. They are nearly vertical. A striking feature is the persistence of the lodes in length and the fairly uniform widths. Bulges or pinches do not occur, but the lodes frequently split into veins, the aggregate widths of which are usually that of the lodes where solid.

Nearing the lateral limits the lodes become reduced in size, and usually split up into small veins. The gangue consists of quartz accompanied by fluorite, mica, and topaz, and the minerals are cassiterite, wolframite, scheelite, bismuthinite, bismutite, and pyrite. Chalcopyrite and molybdenite also occur sparingly, and galena has been noted. The rocks strike north and south, and dip to the west. The ore-bearing lodes traverse these at right-angles to the strike, and pass from the quartzite to the overlying garnet without change. A faulting of some 3 ft. occurs at the contact, which dips about 50° to the west. The ore does not occur in shoots, but is irregularly distributed, and it is consequently necessary to take out the whole length of the lodes to avoid missing the richer patches, of which there is usually no indication until they are met. The lodes have no walls, and, as there is no gouge, they cannot be broken down separately. It is therefore necessary to break the country-rock on each side to the working width of drift or stope. A disadvantage exists in that a considerable amount of waste-rock is mixed with the ore, and this especially when the lodes split into veins which separate over a width of several feet. Basalt covers the western portions of the lease to the extent of nearly two-thirds of the area (320 acres), but fortunately the quartzite and garnet rocks show up along the eastern boundaries, thus enabling the lode outcrops to be picked up and followed under the basalt.

At present the greatest depth of the workings from the surface is 300 ft., and the lodes at this depth, as compared with those at the surface, do not show any serious lowering in tenor in tin and tungsten. The bismuth tenor, however, does show a reduction, as the richer patches were found near the surface. Some of these patches yielded as much as two tons of carbonate of bismuth.

The lodes are worked by adits and from a main shaft. No. 3 adit, which is the lowest, has been driven southeasterly for 1230 ft. This adit is the main outlet to the mill. The main shaft has been sunk to the present depth of 171 ft. below No. 3 adit, and was also raised through to the surface, a distance of 96 ft. The main shaft is 11 ft. 6 in. by 4 ft. inside the timbers, and is divided into three compartments, of which two are used for hoisting and a third for ladders and pump-way. Hoisting is done mainly by an air-winch situated at No. 3 adit, to which level the ore is raised and trammed to the mill on trucks of 11 cu. ft. capacity. At the surface a second winch and head-frame have been installed, and as an alternative this plant is used, under steam, during shortage of water for power. In this event the ore is hoisted to the surface and sent to a dump with a capacity of 1000 tons,

*Abstracted from the proceedings of the Australasian Institute of Mining Engineers.

whence it can be drawn off, through a pass, to No. 3 adit level, as required. This is useful especially when milling has to be suspended owing to dry periods or repairs, and enables development work, at least, to be carried on independent of milling.

The methods adopted in development work and ore-breaking are as follows: Levels are driven along the lodes for convenient lengths, say 200 to 300 ft. The drilling is done with 2½-in. Holman reciprocating machines rigged on upright bars with cross-arms; 1½-in. octagon steel, with chisel bits, is used. Where practicable two headings are driven alternately by the machine-men, who, after drilling out one end, shift to another, and while they are engaged in drilling the second the first is blasted and cleaned up. When the level has been driven for the required distance, a start is made from the end to stope the back of the level. For this purpose telescope hammer-drills are used, operating from the floor of the level; the temporary air and water pipes are taken off as stoping progresses. 'Uppers' 4 ft. in height are drilled, spaced 2 ft. 6 in. apart, and staggered on each side of the lode. Blasting closely follows the drilling, and a second cut 4 ft. in height is drilled and fired. The broken ore is left on the floor of the level until the whole length is broken down to a height of about 15 ft. above the rails. The back of the stope is left drilled out for its whole length, and, these operations being completed, a start is made to tram the ore. As the ore is removed it is followed closely by the timbering, and the waste-rock is hand-picked and thrown on top of the timber. Chutes and man-ways are formed, and a minimum depth of 2 ft. of filling is placed on the lagging. Shoveling boards are laid on top of this filling, which has first been covered with a layer of sacking to avoid loss of fine ore in the interstices. It is usual, to avoid breakage of caps or stulls, to put in a temporary centre leg. This precaution has been found necessary, as occasionally the force of the blast will be downward, and in such instances the filling does not always save breakage. The timber used is 7 by 7-in. split hardwood lagged with 6 by 1½-in. split laths. The caps or stulls are hitched into the walls, and supported by one or two legs, according to the span or circumstance. The objective, however, is to have the stulls or caps independent, as far as possible, of the legs, although these are put in. This is useful in taking out the last stope of the level below, and facilitates the picking up of timbers during that work. In the stoping operations one or more machines are set to work to drill the back of the stope for its whole length, which may be 300 ft. or more. This being completed, the machines are moved to another stope, and blasting is done in several sections along the first stope. After two 4-ft. cuts are broken down the waste rock is hand-picked and the ore is shoveled into passes.

The machine-men, both on Holman and telescope-machines, do not usually do their own blasting, but as far as practicable are engaged for their whole time in drilling. The amount of waste rock does not suffice for fill-

ing, and this is supplemented from other sources; but if such is not available, stulling is put in and another start is made above. The rock is good for standing, and there is no side weight or pressure. It is probable, however, that, as the workings at the shaft levels become more extensive, rill stoping will be resorted to, and all the broken material will be sent to the surface, where sorting can be done on a picking-table or belt and the waste-rock sent down through passes to the stopes for filling. The underground work is all done on wages, and no contracting is at present in vogue.

THE MILL. In considering the flow-sheet, the nature of the ore requires some little explanation. The lodes consist mainly of quartz of a fairly friable nature, enclosed in rocks which are hard. The minerals are easily freed from the gangue, and probably 60 to 70% is already freed before reaching the mill. The wolframite and bismuthinite occur in lumps and patches, and the cassiterite in coarse grains up to ½ in. or more in diameter. After the ore has passed through the rock-breaker little remains to be freed, and after reduction by the rolls to a maximum of ½ in. diameter, practically the whole of the balance is liberated. Thus, reduction does not enter largely into the process. The country-rock, especially the quartzite, contains fine grains of pyrite disseminated through it, and the garnet rock contains much magnetite. The objective, therefore, is to liberate the valuable minerals and as little as possible of the impurities.

The concentrates from all machines in the mill are produced in two grades—namely, 'firsts' and 'seconds'. The objective with regard to the 'firsts' is to retain all the valuable minerals, but to reject the pyrite and silica, and with the 'seconds' to retain the pyrite and reject the silica as far as practicable. By making a 'seconds' product it is possible to aim at a clean 'firsts' product which is practically free from pyrite and magnetite.

The percentages of contents of 'firsts' and of 'seconds' are approximately as follows:

'Firsts'	%	'Seconds'	%
Sn	35.0	Sn	12.0
WO ₃	35.0	WO ₃	10.0
Bi	2.5	Bi	3.5
Total	72.5	Total	25.5

With the large amount of magnetite which occurs in the inseparable country-rock in the mill ore, any attempt to obtain clean 'firsts' only must result in loss. A 'seconds' product retaining the pyrite and a considerable amount of magnetite is therefore made—not that the pyrite and magnetite are of value, but because they cannot be rejected in wet concentration without loss of metal.

The first step in milling is reduction by a rock-breaker. The ore is hand-fed to this machine, and the feeding is regulated by the capacity of the mill, or, vice versa, the rate of feeding regulates the amount milled. The capacity of the mill is 4 tons (of 22 cu. ft.) per hour, and the feeding of this is, with good facilities, quite within the power of a strong boy. In addition, the feeder picks out from the ore any pieces of steel.

It is proposed to install a bin between the breaker and the rest of the mill, and use a mechanical feeder. Some little difficulty, however, exists in that such a course will necessitate the breaker being run 'dry', and, as a proportion of the ore is wet, probably a tendency to clog in the breaker will occur. The main advantages will be in regular feeding and in having the breaker as a separate unit, the stoppage of which will not involve the stoppage of the mill. The breaker is of the Blake type, the jaw opening being 9 by 16 in. Manganese steel liners of hollow pattern are used. From the breaker the ore, assisted by water jets, passes to a conical trommel 4 ft. 6 in. long and 24 in. to 33 in. diam. The screens are punched with $\frac{1}{2}$ -in. round holes, and make 20 r.p.m. The under-size passes to a series of trommels and the over-size to the rolls. The rolls are 26 in. diam. by 10 in. face, and are gear-driven at 35 r.p.m. From the rolls the ore is raised by a bucket-elevator to a cylindrical trommel 22½ in. diam. by 6 ft. long, the screen of which is punched with $\frac{1}{2}$ -in. holes. The over-size from this trommel returns to the rolls and the under-size to the series of trommels, the largest screens having $\frac{3}{8}$ -in. holes and the smallest $\frac{1}{16}$ -in. The sized products from these trommels go to jigs, which yield products from sieves through gate discharges and from hutches. From the gates from the first compartments the $\frac{3}{8}$ -in. and $\frac{1}{4}$ -in. over-size consists of 'firsts' concentrates; these are hand-picked for bismuth ore and for scheelite, and are then bagged as 'firsts'. From the gates from the second compartments the concentrates, after hand-picking for bismuth ore and scheelite, are passed through a pair of 18 by 10-in. rolls and are then returned to the mill circuit. From the hutches of the first compartment is obtained a product which, after hand-sieving, is good enough for 'firsts'; and from the hutches of the second compartment is obtained a product that either is made good enough for 'seconds' by the same process or is returned to the mill circuit. The sizes from the $\frac{3}{8}$ -in. and $\frac{1}{16}$ -in. trommels are fed to suitable jigs, and the under-size from the $\frac{1}{16}$ -in. passes to a pair of hydraulic classifiers. Spigot discharges from these classifiers provide feed for a fine jig. The overflow from the hydraulic classifiers passes to two Rittinger classifiers, from which the spigots feed Wilfley tables, and the overflow goes to a two-compartment settler. Although a fairly good concentrate is obtained from the tables, it is not considered advisable, on account of the varying metal contents of the feed, to attempt to make a clean product. The tailing from the Wilfley tables was for a time passed over a fine jig, but the results did not justify this. The settler provides feed for two Frue vanners.

All the concentrates produced are drained and dried. The drier is constructed of two $\frac{1}{4}$ -in. plates, 6 ft. long by 3 ft. wide, with angle-iron sides, laid in tandem on brick walls. A small furnace at one end, so arranged that the flame does not come in contact with the plates, provides the heating. After drying, the concentrates are bagged in 1-cwt. bags and dispatched to a magnetic separation works at Launceston and owned by the Syndicate.

Power.—Water-power for compressor, pumps, concentrating mill, and saw-bench is obtained from a race 5¼ miles long. The grade of the race is 16 ft. per mile, and the width at bottom is 20 in. The race passes through forest country and frequently along precipitous sidings. The fall of 16 ft. per mile is necessary to prevent accumulations of leaves and debris; and the basaltic soil in which the race is excavated does not cut, but rather tends to wear rounded with this fall. The main pipeline is 1700 ft. long, and ranges in diameter from 20 in. at the intake down to 11 in. at the mill. Branches convey the water to the pumping plant and to the compressor drive. In all cases Pelton wheels are used under heads of 350 ft. at the compressor and pumps and 375 ft. at the mill. For the rock-breaker, the speed of which is variable, a 36-in. diam. Pelton wheel is provided. A 60-in. diam. Pelton wheel drives the rolls, trommels, elevator, and coarse jigs, the speed of which to a certain extent is variable according to the work on the rolls. A $\frac{3}{4}$ -in. nozzle is used for this wheel, and a $\frac{1}{2}$ -in. nozzle for the fine jigs, Wilfleys, and vanners.

For air-compression a two-stage enclosed type belt-driven machine, of 400 cu. ft. free-air capacity, is driven by a 44-in. Pelton wheel. The nozzle diameter is 1½-in., and a 12-in. link leather belt is used as a drive from Pelton wheel to compressor.

The water supply can be relied upon for 9 to 10 months of the year. Storage is not obtainable within 6 or 7 miles of the mine, and beyond this only to a limited extent. To obtain a supply of water for the whole year would involve a heavy capital expenditure, and there would still be doubts as to its permanency. As a standby an auxiliary steam-plant has been installed. This consists of two Robey locomotive-type boilers, each of 500 sq. ft. heating surface, with fire-boxes adapted for 5-ft. wood. The steam pressure is 135 lb. per square inch. A vertical high-speed 2-stage air-compressor, with compound steam ends, has a capacity of 400 cu. ft. of free air. When water-power is available and compressed air is cheap, hoisting is done by an air-winch, situated at No. 3 adit. As an alternative, a steam-winch at the surface is used for hoisting ore and water. With good wood (myrtle and sassafras cut green and allowed to dry), one boiler is able to steam for compressor and hoist on a consumption of about 220 cu. ft. of wood per 8-hour shift. This includes the wood necessary for raising steam.

Since milling was started by the present owners, in 1907, the quantity milled to December 31, 1918, has been 72,884 tons of 22 cu. ft. The production of concentrates from this has been as follows:

	Tons
'Firsts', containing Sn, WO ₃ , and Bi.....	822.00
'Seconds', containing Sn, WO ₃ , Bi, and pyrite.....	354.55
Slime, containing Sn, WO ₃ , and Bi.....	60.95
Bismuth ore, hand-picked.....	20.80
Wolframite, hand-picked.....	3.25
Tin ore.....	0.05
Total concentrates.....	1273.60

The development footage during this period, including sinking, driving, and raising, totals 11,877½ feet.

Registration of Engineers

*Because of widespread and persistent interest in the subject of licensing or registering engineers, architects, and surveyors, Engineering Council, at its meeting of October 25, 1918, authorized the creation of a committee to make a thorough study and submit a report. Fifteen engineers from all parts of our country, and of long experience in the various branches of the profession of engineering, were appointed as members of this committee. After fourteen months of work, the committee presented a report to Engineering Council at its meeting December 18, 1919. This report is accompanied by a "recommended uniform registration law, to regulate the practice of professional engineering, architecture, and land surveying". Council voted to receive this report and to give it immediately, together with the proposed law, as wide publicity as could be secured with the aid of the engineering and architectural societies, and the technical journals, in order that the members of these professions might be informed and discussion elicited to guide Council in the consideration of this important matter at its meeting in February 1920. Engineering Council has as yet taken no action upon the merits of the question of the advisability of legislation providing for the registering or licensing of practitioners of the professions named.

The first work of the committee was to investigate the general subject and to collect, so far as possible, available material bearing upon the subject in hand, including opinions from many engineers as to the need or desirability of legislation, as well as copies of all State laws passed and proposed, having to do with licensing or registration of engineers, architects, and surveyors. This preliminary investigation disclosed that very pronounced views were held by engineers throughout the country, both for and against State licensing or registration. The general sentiment one year ago was more opposed to such measures than it is today. The older members of the profession did not as a rule favor licensing, nor did they feel there was need for State regulation of engineering practice, while among the younger men there was a feeling that licensing or registration by the States would add prestige to professional engineers and in many ways benefit the profession, as well as individual engineers.

The advantages claimed for State licensing or registration are the same as those presumably gained by the laws regulating the professions of law and medicine, namely, that those who are incompetent and unqualified professionally to practise are unable to obtain certificates or licenses, and hence both the public and the profession are protected. On the other hand, those engineers who have already attained to recognized professional standing

feel that they not only do not need the benefits claimed for such legislation, but also they fear that State licenses or certificates of registration are apt to put the seal of State endorsement on men who do not deserve it, and that the public would assume that a licensed or registered engineer was thereby certified by the State as fully qualified, regardless of what might or might not be the requirements demanded before a license or certificate was granted.

However, the question has gone beyond the stage of debate, for already ten States† have enacted laws licensing or registering engineers, and other States are certain to enact similar laws during the present or coming sessions of their legislatures. In addition to these ten laws governing engineering practice, there are at least six States that require the licensing or registration of land surveyors and in at least eighteen States,‡ laws have been passed licensing or registering architects. Some of these ten laws are so drawn as to include both engineers and surveyors and some include engineers and architects and one or two include engineers, architects, and surveyors. Moreover, these laws are not at all uniform and in several instances are likely to prove seriously embarrassing and annoying to engineers whose activities extend beyond the limits of a single State. Because of the nature of professional engineering work the practice of an engineer frequently extends over several States and therefore it is vitally important, if there are to be State regulations for engineering practice, that these regulations be made uniform so far as possible and that the engineering profession unite in wisely directing such legislation.

Unfortunately, some of the laws for licensing architects have been so drawn as seriously to interfere with legitimate engineering practice, and the 'model law' proposed and advocated by the American Institute of Architects contains definitions of architecture and building which, should such laws be passed and enforced, would prevent anyone but a registered architect from planning or supervising the construction of any structure or any of the appurtenances thereto; consequently under this head would come a structure having simply foundations and girders, whether with or without appurtenances. This matter thus becomes of vital importance to mechanical, electrical, sanitary, and mining engineers, as well as to structural engineers.

The committee made a careful study of definitions for 'engineer', 'engineering', 'architect', and 'architecture', but it was found that any definitions for engineering

†Colorado, Florida, Idaho, Illinois, Iowa, Louisiana, Michigan, Nevada, Oregon, Wyoming.

‡California, Colorado, Florida, Idaho, Illinois, Louisiana, Michigan, Montana, New Jersey, New York, North Carolina, North Dakota, Oregon, Pennsylvania, South Carolina, Utah, Washington, Wisconsin.

*Abstract of the report of the committee as submitted to Engineering Council.

would be so general as to include too much, or too specific to be sufficiently general, or too voluminous to be suitable to incorporate in a law. Some have endeavored to include in a definition of 'engineering practice' all sorts and kinds of construction work, but engineering includes investigations as well as plans and no catalogue can well be prepared sufficiently detailed to include all sorts of engineering activities. Both engineering and architecture are broad terms involving construction, and necessarily there can be no sharply-drawn distinction. Architects in the broadest sense are engineers, even if usually architecture is associated with ideas of artistic or decorative features. Land surveying does not involve matters that would ordinarily jeopardize life and health, but property rights are vitally affected by land surveying, and many States have deemed it essential to place restrictions and safeguards about the practice of land surveying. Land surveying is associated with both engineering and architectural practice.

This committee therefore deemed it advisable and to the best interests of all concerned to include in one law provisions for the registration of engineers, architects, and land surveyors. It recognizes that the practices of engineering and architecture overlap in many instances, especially in connection with the larger projects of modern structures, where many branches of the arts and sciences are combined, involving architecture, structural, mechanical, electrical, sanitary, and other lines of engineering.

In fixing the qualifications for registration in the proposed bill, these were purposely made high, but they have not been made unnecessarily difficult for reasonably competent men to meet. It is not intended that candidates would ordinarily be subjected to written examinations, but rather that the board of registration would pass upon the sufficiency of the professional record of each candidate. Minimum qualifications have been clearly set forth which must be met. In order to enable the Board to pass upon candidates fairly, certain qualifications are specified as 'prima facie evidence of fitness', which (unless other facts derogatory to a candidate are also in evidence) will permit the Board to pass the candidate.

This 'prima facie evidence' is not required, but if the candidate can present such evidence his application is the more readily passed upon. For instance, a candidate need not be a graduate of a college of engineering or architecture, but if he is, it is to his advantage. Likewise a candidate need not be a full member of one of the national technical societies or institutes, but if he has won such full membership it is greatly to his professional advantage.

The salient points of the bill, as recommended by the committee for adoption by each State, follow. These are necessarily somewhat condensed, but the matter omitted mainly involves the operation of details, and does not affect the principles involved:

Title: An Act to regulate the practice of professional engineering, architecture, and land surveying.

Section 1: In order to safeguard life, health, and property, any person practising or offering to practise professional engineering, architecture, or land surveying in this State shall hereafter be required to submit evidence that he or she is qualified so to practice, and shall be registered as hereinafter provided, and from and after months after this Act becomes effective it shall be unlawful for any person to practise or to offer to practise professional engineering, architecture, or land surveying in this State, unless such person has been duly registered under the provisions of this Act.

Section 2: Nothing in this Act shall be construed as requiring registration for the purpose of practising professional engineering, architecture, or land surveying by an individual, firm, or corporation on property owned or leased by said individual, firm, or corporation unless the same involves the public safety or health.

Note: Obviously no modern agriculturist should be prohibited from laying out and building the ditches or roads on his farm, or planning and building his own barn.

Section 3: To carry out the provisions of this Act there is hereby created a State Board of Registration for professional engineers, architects, and land surveyors hereinafter called the 'Board', consisting of seven members, who shall be appointed by the Governor within sixty days after this Act becomes effective. At least three members shall be professional engineers, and at least three members shall be architects. Not more than one member of said Board shall be in the same branch of the profession of engineering. The Governor may remove any member of the Board for misconduct, incompetency, or neglect of duty. Vacancies in the membership of the Board, however created, shall be filled by appointment by the Governor for the unexpired term.

Section 4: Each member of the Board shall be a citizen of the United States and a resident of this State at the time of his appointment. He shall have been engaged in the practice of his profession for at least ten years and shall have been in responsible charge of work for at least five years. He shall be a member in good standing of a recognized society of professional engineers or architects, and except as provided in Section 5, shall be a registered professional engineer or a registered architect.

Section 5: Each member of the Board shall receive a certificate of appointment from the Governor, and before beginning his term of office he shall file with the Secretary of State the constitutional oath of office. The Board or any committee thereof shall be entitled to the services of the Attorney General, in connection with the affairs of the Board, and the Board shall have power to compel the attendance of witnesses, may administer oaths, and may take testimony and proofs concerning all matters within its jurisdiction.

Section 6: The Board shall hold a meeting within thirty days after its members are first appointed, and thereafter shall hold at least two regular meetings each year. Special meetings shall be held at such times as the by-laws of the Board may provide. A quorum of the

Board shall consist of not less than two engineer and two architect members.

Section 7: The secretary of the Board shall receive and account for all moneys derived from the operation of this Act and shall pay them to the State Treasurer, who shall keep such moneys in a separate fund. All expenses certified by the Board as properly and necessarily incurred in the discharge of its duties, including authorized compensations, shall be paid out of said fund.

Note: The administration of the law is made ultimately self-supporting. The legislature is not expected to appropriate money to accomplish the results contemplated.

Section 8: The Board shall keep a record of its proceedings and a register of all applicants for registration showing for each, the date of application, name, age, educational and other qualifications, place of business and place of residence, whether or not an examination was required and whether the applicant was rejected, or a certificate of registration granted, and the date of such action. A roster showing the names and places of business and of residence of all registered professional engineers, architects, and land surveyors shall be prepared by the Secretary of the Board during the month of of each year; such roster shall be printed by the State out of the fund of the Board as provided in Section 7, and a copy mailed to and placed on file by the clerk of each incorporated city, town, and county in the State.

Section 9: The Board shall, on application therefor, on prescribed form and the payment of a fee of dollars, issue a certificate of registration.

Note: The application required should include a complete statement of an applicant's education and a detailed summary of his technical work. The statements made should be under oath, and should be supported by the recommendations of not less than two professional engineers, architects, or land surveyors as vouchers.

1. To any person who submits evidence satisfactory to the Board that he or she is fully qualified to practise professional engineering, architecture, or land surveying; or

2. To any person who holds a like unexpired certificate of registration issued to him or her by proper authority in any State or Territory of the United States, or in any Province of Canada, in which the requirements for the registration of professional engineers, architects, or land surveyors are of a standard satisfactory to the Board;

Provided, however, that no person shall be eligible for registration who is under twenty-five years of age, who is not a citizen of the United States or Canada, or who has not made declaration of his or her intention to become a citizen of the United States, who does not speak and write the English language, who is not of good character and repute, and who has not been actively engaged for six or more years in the practice of professional engineering, architecture, or land surveying of character satisfactory to the Board. However, each year of teaching, or of study satisfactorily completed, of engineering or architecture in a school of engineering or architecture of

standing satisfactory to the Board, shall be considered as equivalent to one year of such active practice.

Note: The functions of the Board are largely administrative and judicial. The burden of presenting evidence of qualification is placed upon the applicant. The Board may in doubtful cases give technical examinations; but the clear intent is to utilize other State agencies, as for instance the engineering or architectural schools, to submit as evidence the results of examinations, with recommendations as to competency.

Unless disqualifying evidence be before the Board, the following facts established in the application shall be regarded as 'prima facie evidence', satisfactory to the Board, that the applicant is fully qualified to practise professional engineering, architecture, or land surveying.

Note: When the law goes into effect a large percentage of practising engineers, architects, and land surveyors will be registered to preserve the *status quo*. Long-continued practice, graduation from a technical school of approved standing with subsequent years of practice, or membership in high-grade technical societies, in the absence of disqualifying facts, is accepted as 'prima facie evidence' of qualification, as stated below.

(a) Ten or more years of active engagement in professional engineering, architectural, or land surveying work;

(b) Graduation, after a course of not less than four years, in engineering or architecture, from a school or college approved by the Board as of satisfactory standing, and an additional four years of active engagements in professional engineering, architecture, or land surveying work;

(c) Full membership in American Institute of Architects, American Society of Civil Engineers, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Naval Architects and Marine Engineers, or such other national or State engineering or architectural societies as may be approved by the Board, the requirements for full membership of which are not lower than the requirements for full membership in the professional societies or institutes named above.

Applicants for registration, in cases where the evidence originally presented in the application does not appear to the Board conclusive or warranting the issuance of a certificate, may present further evidence which may include the results of a required examination, for the consideration of the Board.

Note: The standard of qualification is set high for two reasons: The public welfare will be better promoted by maturer competency; and the prestige attaching to the term 'Registered' will be more significant for the professional men themselves. In requiring the younger, less experienced men to serve somewhat longer as assistants or understudies to older men, no hardship is imposed which will not be compensated by the fuller return in recognition when registration is achieved.

In determining the qualifications of applicants for registration as architects, a majority vote of the architect members of the Board only, shall be required; and in determining the qualifications of applicants for registration as professional engineers or land surveyors, a majority vote of the engineer members of the Board only, shall be required.

Note: The acceptance for registration of engineers by the engineers on the Board, and of architects by the architects on the Board, places the judicial finding of fitness or unfitness in the hands of those best qualified to judge. In administrative matters and in the revocation of certificates, the Board acts as a unit.

In case the Board denies the issuance of a certificate to an applicant, the registration fee deposited shall be returned by the Board to the applicant.

Certificates of registration shall expire on the last day of the month of following their issue or renewal and shall become invalid on that date unless renewed. The failure on the part of any registrant to renew his certificate annually in the month of shall not deprive such person of the right of renewal thereafter, but the fee shall be increased 10% for each month or a fraction of a month that payment for renewal is delayed, provided, however, that the maximum fee for a delayed renewal shall not exceed twice the normal fee.

Note: The amount of the fee to be paid by a registrant must be established by each State in the light of the number of fees to be expected, and the cost of administration.

Section 10: The Board shall have the power to revoke the certificate of registration of any professional engineer, architect, or land surveyor registered hereunder who is found guilty of any fraud or deceit in obtaining a certificate of registration or of gross negligence, incompetency, or misconduct in the practice of professional engineering, architecture, or land surveying. Any person may prefer charges of such fraud, deceit, negligence, incompetency, or misconduct against any professional engineer, architect, or land surveyor registered hereunder; such charges shall be in writing and sworn to by the complainant and submitted to the Board. Such charges, unless dismissed without hearing by the Board as unfounded or trivial, shall be heard and determined by the Board within three months after the date on which they are preferred. A time and place for such hearing shall be fixed by the Board. A copy of the charges, together with a notice of the time and place of hearing, shall be legally served on the accused at least thirty days before the date fixed for the hearing, and in the event that such service cannot be effected thirty days before such hearing, then the date of hearing and determination shall be postponed as may be necessary to permit the carrying out of this condition. At said hearing the accused shall have the right to appear personally and by counsel and to cross-examine witnesses against him or her and to produce evidence and witnesses in his or her defense. If after said hearing five or more members of the Board vote in favor of finding the accused guilty of any fraud or deceit in obtaining a certificate or of gross negligence,

incompetency, or misconduct in the practice of professional engineering, architecture, or land surveying, the Board shall revoke the certificate of registration of the accused.

The Board may re-issue a certificate of registration to any person whose certificate has been revoked, provided five or more members of the Board vote in favor of such re-issue for reasons the Board may deem sufficient.

The Board shall immediately notify the Secretary of State and the clerk of each incorporated city, town, and county in the State of its findings in the case of the revocation of a certificate of registration or of its re-issuance of a revoked certificate of registration.

Note: Revocation is recognized as a serious procedure in its effect on professional reputation, and the right of hearing and contest is recognized and provided for.

Section 11: The issuance of a certificate of registration by this Board shall be evidence that the person named therein is entitled to all the rights and privileges of a registered professional engineer, registered architect, or registered land surveyor while the said certificate remains unrevoked or unexpired.

Each registrant hereunder shall upon registration obtain a seal of the design authorized by the Board, bearing the registrant's name and the legend 'registered professional engineer', or 'registered architect', or 'registered land surveyor'. Plans, specifications, plats, and reports issued by a registrant may be stamped with said seal during the life of registrant's certificate, but it shall be unlawful for anyone to stamp or seal any documents with said seal after the certificate of the registrant named thereon has expired or has been revoked unless said certificate has been renewed or re-issued.

Section 12: Any person who after this Act has been in effect months is not legally authorized to practise professional engineering, architecture, or land surveying in this State according to the provisions of this Act and shall so practise, or offer so to practise in this State, except as provided in Section 13 of this Act, and any person presenting or attempting to file as his own the certificate of registration of another, or who shall give false or forged evidence of any kind to the Board, or to any member thereof, in obtaining a certificate of registration, or who shall falsely impersonate any other practitioner, of like or different name, or who shall use or attempt to use an expired or revoked certificate of registration, shall be deemed guilty of a misdemeanor and shall for each such offense of which he is convicted be punished by a fine of not less than one hundred dollars (\$100) nor more than five hundred dollars (\$500), or by imprisonment for three months, or by both fine and imprisonment. However, nothing in this Act shall be construed as excluding any registered architect from the practice of professional engineering or as excluding any registered professional engineer from the practice of architecture.

Note: By reason of overlapping of the fields of engineering and architecture, a clear line of demarcation cannot be made between these two professions. As this Act does not prohibit a chemical engineer from building a

steel arch bridge, it appears inconsistent to prohibit an architect from building such a bridge, or a structural engineer from building a church. Ethical considerations and professional opinion must confine the scope of each person's practice to the fields in which he is a master.

Section 13: The following shall be exempted from the provisions of this Act:

1. Offering to practise in this State as a professional engineer, architect, or land surveyor, by any person not a resident of and having no established place of business in this State.

Note: A professional card in a journal of national circulation is an "offer to practise" in any State in the Union. It would be manifestly unfair to compel a professional man to register in every State in which he may in this way, or by letter or otherwise, express his readiness to accept an engagement.

2. Practice as a professional engineer, architect, or land surveyor in this State by any person not a resident in this State and having no established place of business in this State, when this practice does not aggregate more than fifteen days in any calendar year; provided, that said person is legally qualified for such professional service in his own State or country.

Note: It is a distinct advantage to the people of any State to be able to call in for consultation a specialist from any other State. Such practice may be brief and often of an emergency nature.

3. Practice as a professional engineer, architect, or land surveyor in this State by any person not a resident of and having no established place of business in this State, or any person resident in this State, but whose arrival in the State is recent; provided, however, such a person shall have filed an application for registration as a professional engineer, an architect, or a land surveyor and shall have paid the fee provided for in Section 9 of this Act. Such exemption shall continue for only such reasonable time as the Board requires in which to consider and grant or deny the said application for registration.

4. Engaging in professional engineering, architecture, or land surveying as an employee of a registered professional engineer, a registered architect, or a registered land surveyor, or as an employee of a professional engineer, architect, or land surveyor, authorized by paragraphs 2 and 3 of this section, provided that said practice may not include responsible charge of design or supervision.

5. Practice of professional engineering, architecture, and land surveying solely as an officer or as an employee of the United States.

6. Practice of professional engineering, architecture, or land surveying solely as an employee of this State or any political subdivision thereof, at the time this Act becomes effective and thereafter only until the expiration of the then existing term of office of such employee.

Section 14: A corporation or partnership may engage in the practice of professional engineering, architecture, or land surveying in this State, provided the person or

persons connected with such corporation or partnership in charge of the designing or supervision which constitutes such practice is or are registered as herein required of professional engineers, architects, and land surveyors. The same exemptions shall apply to corporations and partnerships as apply to individuals under this Act.

Section 15: One year after this Act goes into effect, neither the State nor any county, township, city, town, or village, nor other political subdivision in the State, shall engage in the construction or maintenance of any public work involving professional engineering or architecture for which the plans, specifications, and estimates have not been made by, and the construction and maintenance supervised by, a registered professional engineer, or a registered architect; provided, that nothing in this section shall be held to apply to such public work wherein the contemplated expenditure for the completed project does not exceed two thousand dollars.

Section 16: Land surveying as covered by this Act refers only to surveys for the determination of areas or for the establishment or re-establishment of land boundaries and the subdivision and platting of land. Nothing in this Act shall be construed as prohibiting registered professional engineers or registered architects from making land surveys where such surveys are essential to engineering or architectural projects.

Section 17: All laws or parts of laws in conflict with the provisions of this Act are hereby repealed.

THE FUEL SUPPLY for the Province of Ontario comes largely from the United States. In the fiscal year ending March last the value of the coal and coke exported into Canada was \$79,000,000, and two-thirds of it was consumed in Ontario. For the previous fiscal year the actual tonnage of coal imported into the Province was 16,250,000, out of a total for the entire Dominion of 21,649,000 tons. The industries of Ontario have frequently suffered from interruptions arising from labor and transportation difficulties, and the serious nature of these interruptions forced itself on the attention of the public during the War, when the supply of the much-needed munitions, 53% of which was produced in Ontario, was limited through this cause. Fear of the recurrence of such conditions and apprehension as to the supply of fuel for domestic purposes gave rise to more active efforts for the utilization of local sources of fuel. Although Canada as a whole has coal resources greater than those of any country in the world with the exception of the United States, the mines are farther from the industrial centres of Ontario than are the coalfields in neighboring States. Ontario has, however, large beds of peat, the commercial uses of which have been investigated by Government experts, and they are now able to report practical results. It has been determined that peat can be used in combination with coal; and while it will not take its place, it promises to reduce dependence on imported fuel. Tests made at Alfred, Ontario, indicate that peat ready for use can be supplied at \$3.50 per ton at that point.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

DEVELOPMENT BY THE COPPER QUEEN COMPANY AT BISBEE.

DOUGLAS.—Local stockholders in the Heffern Gold Mining & Milling Co., owning properties in the Leslie Canyon district of the Swisshelm mountains, 25 miles north of here, are awaiting decision in the case of the 'Administrator of the Estate of Albert Heffern, deceased, v. the Heffern Gold Mining & Milling company et al'. The suit sought to foreclose a mortgage of \$10,000 alleged to have been voted by Heffern to himself as

\$50,000. The main shaft, now down 885 ft., will be continued to the 1200-ft. level and before reaching that point there is reason to believe the high-grade copper ore which is being sought will be found. The Copper Queen smelter here produced approximately 8,000,000 lb. of fine copper during January. Calumet & Arizona production was approximately 5,085,000 pounds.

BISBEE.—The annual report of the Employees Benefit Association of the Phelps Dodge Corporation, Copper Queen branch, for the year 1919, has been made public.



SMELTING PLANT OF THE CALUMET & ARIZONA MINING CO., AT DOUGLAS, ARIZONA

majority stockholder in the concern. The defence sets up the plea that although Heffern owned and controlled a majority of the stock he was in duty bound as an officer in the company to safeguard the interests of minority stockholders. The Heffern property contains several thousand feet of work in tunnels and shafts and is said to have a considerable amount of gold ore of milling-grade developed. Practically all of the stockholders are Cochise county people.

E. Frank Jones upon returning here from a month's visit to the United Arizona mine, situated near Mayer, Yavapai county, announced that the mine was about to be re-opened. Much of the stock is held in this district. Mr. Jones said that reputable engineers who had examined the property recently had rendered a favorable report and New York operators who hold the controlling interest had decided to finance the mine to the extent of

This association pays benefits for such injuries or sickness as is not covered by the State's compensation law, namely, for minor accidents, and sickness or death from natural causes. There was a total of 542 accidents of minor nature among the men employed in the mines of the Corporation here during the last year, for which \$6046 was paid in claims, an average of \$11 per claim. There were 68 accidents among men off duty for which \$3234 was paid in claims, an average of \$47 per claim. The State compensation law does not apply to men injured when off duty, so these figures include both serious and minor injuries. There were 737 cases of sickness among employees for which \$26,847 was paid, an average of \$36 in each individual case. Of the white employees of the Phelps Dodge Corporation, 82.8% were members of the association in 1919, while of the Mexicans but 7.1% held membership. The company contributed \$13,958 to the

fund, while the employees themselves contributed directly \$59,529 during the year.

Development and mining operations in the Copper Queen holdings in this district may be briefly stated as follows: Preparations are being made in the Czar division to prospect a large area of practically unexplored ground. About 1000 ft. of pipe is being laid for water and air-lines to be used in driving two drifts on the 200-ft. level. One of these will be driven under the first Copper Queen working in the old 'glory hole', at which point high-grade ore outcropped on the surface and was mined on an incline. Original maps of this section of the company workings date back to 1881. The other drift will be driven under the old workings, to the west of the glory hole. Both drifts will be carried to the Dividend fault. Besides having prospecting value themselves, they will serve as points from which to prospect territory farther to the west. The new Southwest shaft has been raised from the fifth to the third level, a distance of approximately 200 ft. Work will be continued from this point to connect with work that has been done from the seventh level and from there will proceed to the surface, emerging near the top of Queen hill, between the Southwest change room and Uncle Sam shaft. The new shaft will possess many advantages over the present one which has but a single compartment equipped with underground hoist and is situated a long distance from the change room and waste dumps. Abandonment of the old shaft will make possible the mining of a large body of ore which cannot be touched at present because it lies in the pillar of ground around the shaft which must be left undisturbed as long as the shaft is in use. Drifts on the Gardner 800, 900, and 1000-ft. levels, and on the Sacramento 1100-ft. level are in the ore. Several hundred feet of development work is being done each month to determine the extent of the orebody. Owing to its high silica-content this ore is greatly in demand at the smelter for converter lining. The new winze of the Sacramento division has been sunk to a depth of about 100 ft. below the 1600-ft. level. Sinking will be continued until the 1800-ft. level has been reached, when drifting to the Dallas shaft will be started.

COLORADO

ACTIVITY AT SILVERTON.

CRIPPLE CREEK.—At the annual meeting of the stockholders of the Golden Cycle Mining & Reduction Co., held at Colorado Springs last week, the former board, including A. E. Carlton, L. G. Carlton, Spencer Penrose, Richard Roelofs, Irving T. Snyder, E. P. Shove, and H. McGarry, was re-elected. The officers will be chosen on February 23 by the directors. The company last year paid 12 monthly dividends of 3c. per share, amounting to \$540,000. A similar dividend was paid on January 10, and the second distribution for 1920 will be made on February 10.

The Main shaft on the Battle mountain property of the Rose Nicol Gold Mining Co. has been sunk to a depth of 1200 ft. by the Reva Gold Mining Co., lessee, and a

station is now being cut preparatory to cross-cutting to the vein, encountered in sinking. Rich ore was obtained from the vein dipping through the shaft and it is hoped a good shoot will be developed.

The northern extension of the rich Maloney vein has been cut at the fifth level of the Empire State shaft of the Isabella company on Bull hill, by Ed Lindsey, lessee. Two cars shipped to date netted between \$30 and \$40 per ton. A. M. Colgin and Denver associates are installing an electric hoist and compressor at the Red Bird mine, on the south-western slope of Gold hill, just beyond the city limits. It is planned to sink the Red Bird shaft deeper and explore the Sherman and Yellow Bird claims adjoining through the Red Bird shaft.

The Caledonia on the southern spur of Gold hill, formerly owned by the late W. S. Stratton and sold by him to a London syndicate, and now owned by R. E. Dolan, of Mineral, Virginia, is again to become active under lease. The mine produced about \$200,000 from shallow workings, before its sale to the Britishers, but never paid expenses while under the English management.

LEADVILLE.—With railroad service restored, shipments are being made from the Hilltop mine at the head of Iowa gulch and on the Park county side of the line. At the present time about 25 tons of silver-lead ore is being hauled daily by team to Fairplay and thence shipped to the Leadville smelter of the A. S. & R. company. A considerable orebody has been opened up and is under development. The vein was found at a depth of 540 ft. and has been proved by drifting for 300 ft. It is said to average 12 ft. in width.

Two cars daily of iron-silver ore is shipped by the Down Town Mines Co. to local smelters. The ore contains some copper, lead carbonate, and zinc oxide. The company has about 120 men on the payroll and is doing extensive exploration work, in addition to current shipping.

As a sequel to the decision of Judge Hersey in the district court over the locus of the line between Lake and Summit counties, there is talk of the removal of one of the big molybdenum mills near Climax across the newly-defined line into Summit county to escape the heavy taxes that prevail in Lake county. This action is proposed by the American Vanadium Co., which has taken over the holdings of the Climax Molybdenum Co.

LAKE CITY.—L. T. Leach and his associates in Indianapolis are making progress in the development of their claims 14 miles from here. They hold 29 claims, partly developed by tunnels, from which they have shipped several carloads of gold-silver ore. Equipment and buildings have been provided for additional work.

SUMMIT COUNTY.—The Wellington mine is producing more zinc than any other property in the State. Two mills are kept running three shifts and 110 men are on the payroll.

SILVERTON.—Production is now on the upward trend, as the Sunnyside is speeding up on milling operations, and all of the mines are increasing their output. The Gold King Extension Mines Co. has opened up good mill-

ing-ore that promises profitable treatment. In addition, a development that promises well for future operations is the recovery of the famous 'Lost Stope'. During the operations of 1908, a cave on the Davis vein, between the No. 3 and 4 levels, resulted in the loss of a large stope containing over 10,000 tons of broken ore and a large block still in position. In the hope of re-locating this stope an exhaustive survey of the workings was made during the period that the mine was closed down, which successfully placed the position of the stope, and its recovery is expected. The ore-shoot is 40 ft. wide and 200 ft. long, and the ore averages \$20. The Gold King is now shipping about a car per week of concentrate by way of Silverton. There is some prospect of the re-opening of the Gladstone branch of the railroad, as the weather of the past few weeks has resulted in rapid melting of the snows.

MICHIGAN

SMALL PROFITS IN LAKE SUPERIOR REGION.

Houghton.—January production of copper from the mines of the Lake Superior district showed practically no increase over the output in December, and there is not likely to be any substantial increase at any of the mines during the year, judging from the present outlook and in view of the labor situation. There is no prospect at this time of increasing labor forces and many of the mines of the district actually are operating at a loss. Very few are earning their dividends and practically none earned the amount disbursed to stockholders last year. Costs at the Ahmeek and Isle Royale were below

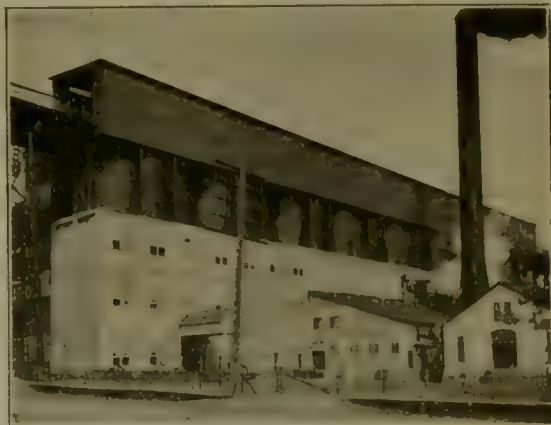


A MASS OF NATIVE COPPER IN A LAKE SUPERIOR MINE

18c., but this was not the case at any other property of the Calumet & Hecla and allied corporations. Neither the Osceola Consolidated, the Allouez, Centennial, La Salle, Superior, nor White Pine companies operated at a profit during the year.

The margin of profit at the Copper Range and the Quincy, both large producers, was closer than it has been for many years, and with depreciation charged in costs, the profit is wiped out. Ahmeek increased its output of ore for January, producing 64,125 tons, compared to 59,802 for December. From the old Osceola branch of

the Osceola Consolidated the output in January was 11,925 tons and from the Kearsarge 43,330, a total of 55,255. This is on a par with December. There was no appreciable difference in the average grade of ore mined at either property. Centennial produced 7695 tons for January, which compares with 6660 in December. Allouez increased slightly, securing 20,000 tons in January. Seven cars were shipped from the La Salle, all of it being from exploration work. Isle Royale showed a slight



AHMEEK STAMP-MILL

increase for January and, in addition to the operation of the Isle Royale mill during the entire month, shipped 8910 tons to the Osceola mill for treatment. Superior shipped no ore at all during the month.

Mayflower's drift on the vein is in 30 ft. at the present time. But one drift, that to the north, is going forward, and the exploration work is being watched with a great deal of interest. The shaft is bottomed at 1765 ft. in solid trap. The lateral is started at 1710 feet.

Hancock Consolidated this week cut No. 12 amygdaloid with a cross-cut on the 44th level. Drifting on the formation will start this week. At the point penetrated the lode was well mineralized and from the appearance it will be the equal of No. 3 lode, which is the richest vein opened east of the shaft. The Hancock is adding to its active underground force. Thirteen drills now are working regularly on two shifts, practically all in ore. Outside of No. 15 conglomerate the whole eastern territory is an enigma to the mining men who have examined it. The copper is found in what is probably a faulting of the Pewabic.

The following figures on cost of production at several mines in the Michigan copper district are approximately correct: Allouez, 21c.; Calumet & Hecla, 18c.; Isle Royale, 15½c.; Osceola, 20c.; Ahmeek, 16 cents.

NEVADA

DEVELOPMENT COMPANY'S PLANS.—PROTEST AGAINST DISCONTINUANCE OF BONUS BY TONOPAH MINERS.

GOLDFIELD.—The mill of the Development company will be treating 500 tons of ore daily by April 1, accord-

ing to A. I. D'Arcy, general manager. The mill-heads will be maintained at from \$15 to \$20 for a long period and the capacity will be increased gradually to 2000 tons as the higher-grade ore is exhausted. Thirty-seven of forty-five 50-ft. raises planned have been driven from the 380-ft. level of the Combination to tap the stope filling. Each raise has a capacity of 200 tons. Twelve thousand tons of ore assaying from \$12 to \$15 is broken in the Red Top. Production from the January mine will be started by blasting the edges of the glory-hole into chutes with an outlet on the 180-ft. level. The better grades of ore in all mines will be mixed with the lower grades to maintain a comparatively high average. The main south-east drift from the Combination shaft has been advanced a short distance over the Florence boundary line. Four raises will soon be started from near the face for the extraction of ore in the old Reilly lease block in the Florence adjoining the Combination. There is exposed in this block 25 ft. of \$16, 5 ft. of \$192, 5 ft. of \$236, and 7 ft. of \$300 ore, left by a lessee who was confident he would secure an extension of his lease after January 1 of this year. The higher grades will be shipped to a smelter. One of the raises recently driven in the Combination has opened 15 ft. of \$15 ore and another has opened 15 ft. of \$25 ore. In widening the junction of one of the three south-east haulage-ways on the 380-ft. level with the cross-cut to the main Development shaft, 9 ft. of \$12 ore has been found. It is planned to mine the January as rapidly as possible, as following this the Combination shaft can be abandoned and the 50 by 50-ft. block that protects the shaft can be taken. The net value of the ore in this block is estimated at \$200,000. Sampling for a length of 60 ft. and to a depth of from 10 to 15 ft. along the north-west side of the January glory-hole gave an average assay return of \$9.60. Inspection of the 280-ft. level of the Combination, in the heart of the material to be caved, shows the ground to be extremely heavy. The timbers are badly crushed and it is evident that the entire territory above the 230-ft., or the level at the top of the raises, is in ideal condition for caving. Exploration of the upper workings shows that the Consolidated company had mined to the limit of safety when work was stopped and that the impossibility of holding the ground economically for further mining was as much responsible for the suspension of operations as the shortage of good-grade ore.

DIVIDE.—According to unofficial reports, a winze being sunk from the 200-ft., or bottom, level of the Divide Extension is being continued from the present depth of 45 ft. in a 6-ft. width of \$600 gold-silver ore, the value of the former being twice that in silver. A drift is being driven west in the vein cut in the north cross-cut on the 200-ft. level of the Victory. The width of the vein, according to the management, "probably is 11 ft." and the value of the ore remains the same as when the shoot was entered in the cross-cut. Shipments from the Tonopah Divide average 25 tons of \$40 ore daily, showing that the output is maintained at a minimum. This is due largely to the limited capacity of the MacNamara mill.

TONOPAH.—E. P. Cullinan, president of the Dividend, in the Divide district, stated a few days ago that the Dividend company would continue to pay a 50-cent wage bonus, disregarding the action of other operators in Tonopah and Divide in discontinuing payment of the bonus. The Tonopah Trades Assembly has protested to the mine operators association against the announced discontinuance of the wage bonus. An increase in prices at the commissary since it was opened is given as the reason for the protest.

OREGON

OPERATIONS RESUMED AT QUEEN OF BRONZE PROPERTY.

WALDO.—A general resumption of copper mining in this district seems probable. Several producing copper mines, which closed down on the suspension of hostilities last November, had shipped ore containing more than 12% copper to the Tacoma smelters, while lower-grade material accumulated on the dumps. It was during the war-period that the smelter operators discovered that the southern Oregon copper ores could be used to advantage as a flux for Alaskan copper ores, and with the smelter in the market for such ore several companies are planning to resume operations. The Blue Ledge copper mine in the Upper Applegate district, just over the line in California, was the only mine in this region to continue shipments after the Armistice. This mine has been operating steadily with a crew of 25 miners, shipping three cars of ore per week.

Work at the Queen of Bronze and associated properties has recently been resumed under lease, and regular shipments are being made. This property is $2\frac{1}{2}$ miles east and south of Waldo and is equipped with a 100-ton smelter. The ore is hauled a short distance to the smelter. This plant has a 125-ton water-jacketed blast-furnace operated semi-pyritically, making matte, averaging 45% copper, 2.5 oz. silver, and \$2.50 gold per ton, that is shipped to the Tacoma smelter for converting. Up to 1910 more than \$150,000 was spent on the property, including the building of the smelter, and more than 20,000 tons of ore was smelted, the average content being $8\frac{1}{2}$ % copper and the usual amount of gold and silver. The ore contains massive chalcopyrite, pyrrhotite, and some pyrite, together with some oxidized minerals. It occurs in a brecciated zone of variable width, in which chunks of massive copper and iron sulphides are found.

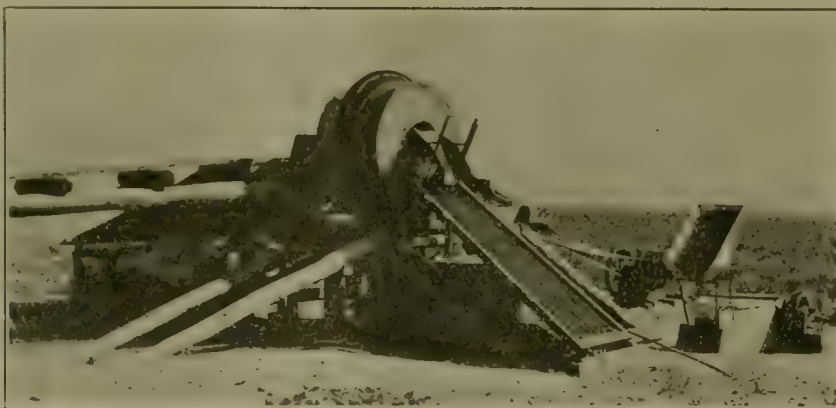
BAKER.—The first dry-placer plant erected in Oregon was successfully operated during the past summer and fall. For many years it has been well known that exceptionally rich placers existed on the high bar or tableland near Baker, but the fact that no water was available rendered the property worthless, although, from time to time, it has been held by various locators, who have prospected the ground and 'packed' the gravel to water, with surprising results. Somewhat over a year ago, W. L. Meeker, of Portland, who had been investigating and making a study of dry concentration, began negotiating with the present owners, and finally obtained a lease, with purchase option. The owners, being skeptical as to pos-

sibility of working the deposit, insisted that suitable machinery or equipment for extracting gold be placed on the ground and successfully operated within a prescribed period of time. The equipment consists of a mounted steel drum, gas-engine for revolving same, a grizzly, wire-screen, feed-hoppers, concentrating table, gas-engine to operate same, and a blacksmith-shop.

The drum is a disintegrator and dryer. The gravel fed into it is churned for a few minutes, then discharged over the grizzly. Small boulders, up to 8 in. diameter, are included in the charge to act as grinders. The material passing over the grizzly is cleaned as though washed in sluice-boxes; what goes over the grizzly is fed over a screen of $\frac{1}{2}$ or $\frac{3}{4}$ -in. openings to the concentrator, which is a table known as the Stebbins, made in Los Angeles. The first operation over the table reduces a cubic yard of ma-

Co. and Utah Consolidated Mining Co. were closed. The final arguments were not completed until late in the afternoon, when Judge Johnson announced that he would take the cases under advisement. Several of the attorneys connected with the companies involved expect a decision within sixty days.

BINGHAM.—During 1919, the Utah Apex Mining Co. produced 54,538 tons of ore, from which was obtained 2257 oz. of gold, 195,715 oz. of silver, 14,753,984 lb. of lead, 7,671,742 lb. of zinc, and 386,833 lb. of copper, the gross proceeds of which amounted to 923,888. During the year the company expended for labor and supplies \$655,098; salaries and similar items, \$42,787; State and local taxes, \$26,285; compensation insurance, \$17,055; reduction expense, \$305,817; transportation on ores, \$50,953, making total expenditures of \$1,097,996. There-



A DRY-PLACER PLANT IN OREGON

terial to approximately 15 lb. of concentrate. This, at the end of the day, or week, is re-treated on the concentrator, and thus further reduced 80 to 90% in bulk. In re-concentrating, the slope and speed of the table are changed. Among the natural advantages is the fact that there is little waste or over-burden to handle. Nowhere does this exceed 20 inches. It is expected that the present equipment will be replaced by a much larger plant this spring.

UTAH

MINE ACCIDENTS DURING 1919.—EUREKA ORE SHIPMENTS.

SALT LAKE CITY.—According to figures released by the Industrial Commission of Utah, nine miners and four employees working on the surface around metal mines were killed during the year 1919, as compared with a total of twenty-three during the previous year. Two men, other than employees, met death in the metal mines during 1919. At the mills and smelters of the State, five employees were killed during 1919, as compared with ten for 1918.

Following the final arguments of Adrian C. Ellis, attorney representing the Utah Consolidated, before Tillman D. Johnson, Judge of the United States District Court, on January 31, the cases of the Utah Apex Mining

fore, there was a deficit on the year's operations of \$174,107. The mine was closed down in April 1919, owing to the condition of the metal markets, and only a small force was kept for development work. Mining operations were resumed in September, but owing to shortage of labor, the output was rather limited until November. The milling plant of the company resumed operations on February 1, 1920. It is understood that a large tonnage of milling ore is available.

ALTA.—Recent thaws have made it impossible for mines to ship ore by sleighs to the valley smelters. It was expected that the January output from the Emma silver mine would total \$40,000, but on account of weather conditions making the roads impassable, the output will be about \$28,000, according to George H. Dern, general manager. Approximately 300 tons, that should net \$40 per ton, await shipment at the mine. A recent shipment of ninety-four tons assayed 61 oz. silver, 9% lead, and 5% zinc and netted \$6866, while another later shipment of eighty-eight tons netted \$5532.

The annual meeting of the stockholders of the Sells Mining Co. was held at Salt Lake City on February 3. At this meeting more than 75% of the issued stock was represented, being a record in the history of the company. V. S. Snow was elected to the board of directors to suc-

ceed A. O. Jacobsen. Following the stockholders' meeting, the board of directors held a meeting and elected John Zink, president; John Gallacher, vice-president; W. H. Weyher, secretary and treasurer; and V. S. Snow and A. W. Joerger, directors. According to information given out by Mr. Weyher, a recent strike of ore in the property gave samples assaying \$14.50 in gold, 240 oz. silver, and 4% copper per ton.

GOLD HILL.—Shipments from the Western Utah Copper property during January totaled about 3750 tons. This is lead-silver ore that is being glory-holed. On the 700-ft. level, development is highly encouraging, and the vein on this level is 62 ft. wide. Changes are being made in the milling plant which will double its present capacity.

EUREKA.—Shipments of ore from this district for the week ending January 31 totaled 149, a decrease of 12 cars as compared with the previous week. The Chief Consolidated shipped 48 carloads; Dragon, 18; Tintic Standard, 15; Iron Blossom, 13; Eagle & Blue Bell, 12; Grand Central, 9; Colorado, 9; Centennial-Eureka, 6; Swansea, 4; Ridge & Valley, 4; Victoria, 3; Mammoth, 3; Sunbeam, 2; Alaska, 2; Tintic Mill (bullion), 1 car.

Excellent progress is being made in sinking the shaft at the property of the Pinion Queen, according to Edward Sutherland, manager. The work is being done under contract at the rate of five feet per day. The shaft has now reached a depth of 450 ft. and the porphyry through which it passes contains iron sulphides, with about \$7 per ton in gold and silver. It is the intention of the management to award another contract which will take the shaft from the 500-ft. level to the 800-ft. level, and it is believed that conditions at the latter point will be favorable for drifting. The Pinion Queen has made better time in sinking its shaft than any other property in the eastern part of the district, 450 ft. having been sunk since October 14.

Through a deal closed on January 31, Eastern interests have acquired control of the Addie Mining Co., whose property in the eastern part of the district consists of five patented claims. The property has had a small amount of development, consisting of a tunnel and two shafts. Work is to be started at once to clean out and re-timber the shafts, preparatory to further work.

During the past week the Tintic mill shipped a car containing 29 tons of bullion, the value of which is \$135,000. This shipment contained more silver and less copper than previous consignments, and is the richest bullion

ever produced at the mill, according to Theodore P. Holt. Ample ore is being secured to enable the company to operate its plant at maximum capacity, most of it coming from the Knight properties.

It is expected that by February 10 new equipment will be in operation at the property of the Independence Mining Co. so that sinking of the shaft can be resumed. This shaft now has a depth of 70 ft., and it is the intention to send it down to the 700-ft. level before undertaking any other development work. This property is north-east of the Tintic Standard. Recent developments in the northern part of the Tintic Standard property lead officials of the Independence to believe there is an excellent possibility of favorable results being obtained in the exploratory work they contemplate.

A new company, to be known as the Silver Star Consolidated, has been organized by residents of Silver City. This company will have thirty-three claims, which are south-east of Silver City. The officers are: William Mott, president; Samuel Werrett, vice-president; W. T. Hatch, secretary and treasurer; A. L. Daley and David Greenhaigh, directors.

BRITISH COLUMBIA

PRODUCTION FIGURES FOR 1919

VICTORIA.—On January 29, at the opening session of the Provincial Legislature, Milliam Sloan, Minister of Mines, announced the preliminary estimate of the metal production of British Columbia. As in several instances the figures differ materially from those published in the issue of December 27—lead, it will be seen being nearly double the amount given then—it is well to publish the official figures in full. In accounting for the great decrease of \$7,815,221, as compared with the value of the output of 1918, Wm. Fleet Robertson, Provincial Mineralogist, says: "This decrease in production, as compared with the preceding year, loses its adverse significance when it is considered that the 1919 production is materially greater than that of any year prior to 1916."

The official figures as included in the report are given in the table at the bottom of this page.

SLOCAN.—The Rambler-Cariboo Mines, Ltd., has made the final payment of \$25,000 on the Last Chance and Jennie claims, which were purchased last July. Since the claims were acquired, the No. 9 level has been extended 250 ft. into the Jennie claim from the Rambler-Cariboo mine, and a strong vein of good ore has been developed. The No. 8 level is within 35 ft. of the Jennie claim, and

British Columbia Metal Production During 1918 and 1919

	Quantity	Value	Quantity	Value	Increase	Decrease
Gold, placer, ounces	16,000	\$320,000	14,325	\$286,500	.....	\$33,500
Gold, lode, ounces	164,674	3,403,812	141,769	2,930,365	.....	473,447
Total gold	.....	\$3,723,812	.....	\$3,216,865	.....	506,947
Silver, ounces	3,498,172	3,215,870	3,667,516	3,871,063	\$655,193	.....
Lead, pounds	43,899,661	2,928,107	32,134,136	1,658,121	.....	1,269,986
Copper, pounds	61,483,754	15,143,449	45,984,046	8,631,205	.....	6,512,244
Zinc, pounds	41,772,916	2,899,040	43,694,583	2,717,803	.....	181,237
Total	.....	\$27,910,278	.....	\$20,095,057	.....	7,815,221

the ore at the face assays as much as 200 oz. of silver per ton. There are several inches of clean sulphide ore in the vein. The last shipment assayed 68% in lead and 139 oz. silver per ton. Three feet of high-grade ore has been exposed between the 7th and 8th levels at the Queen Bess mine. This mine has produced more high-grade than any other mine in the Clarence Cunningham group and the returns from it have largely provided funds for Mr. Cunningham's extensive operations. William Thomlinson has been elected president of the Sloean branch of the British Columbia Prospectors' Protective Association. Mr. Thomlinson has done much to improve the educational facilities for prospectors in the district.

STEWART.—The tunnel on the E Pluribus claim of the Big Missouri mine has struck ore showing native and ruby silver. J. R. McDonald, of New York, who bonded

should install a refinery. The explanation, it is thought, is that the company has American corporate affiliations that make such action impracticable. Hence it is maintained that the Government should take the initiative.

NELSON.—J. R. Hunter, president of the Nelson Board of Trade, in his annual report in referring to the mining situation is quoted as saying:

"The Eureka and Granite Poorman mines have been bonded to Walla Walla capitalists, who are at present driving a long cross-cut on the Eureka with the object of striking the orebodies at greater depth. When this is done and shipping is commenced the ore will be treated at the Granite mill.

"The Molly Gibson has been under development and considerable shipping has been done. The Ivy Fern (Cultus creek) which has been bonded by the Consoli-



THE TRAMWAY OF THE BRITANNIA MINE, HOWE SOUND, BRITISH COLUMBIA

the Unicorn group last fall, has started a tunnel on the claim, notwithstanding the attending difficulties due to the severity of the weather. It is seldom that new work is started in this district in mid-winter. The Premier mine is keeping a continuous stream of ore running between the mine and tide water. The snow-tractors have proved to be a failure.

PRINCE RUPERT.—A delegation from Prince Rupert recently waited on members of the Provincial government, advocating the establishment of a metal refinery in British Columbia. Chief among the arguments in support of the petition is that of the necessity of doing everything possible to readjust the trade balance. With copper going out of the country for refinement to be repurchased in the finished manufactured article by Canada one serious obstacle to the removal of the present intolerable condition was apparent. The opinion is expressed that the Granby Consolidated Mining & Smelting Co., the greatest producer of copper in the Province,

dated Mining & Smelting Co. is being developed by the driving of a cross-cut tunnel to strike the main orebodies at depth. A great deal of surface work also is being done. This is going to be one of the high-tonnage properties of the Interior.

"We might also mention the Nugget, Motherlode, and the Emerald, the last having just completed a new mill for the treating of its ores. Its showings are most satisfactory and it no doubt will be one of the big producing properties."

ONTARIO

COBALT PRODUCES WELL IN JANUARY.

COBALT.—Preliminary estimates place the output of silver from Cobalt during January at 1,000,000 oz., valued at approximately \$1,250,000. The indications are that the number of producing mines in 1920 will exceed that of 1919. All the mines that contributed to last year's output are operating, and a number of smaller

enterprises are being added to the list. Chief among these will be the Bailey-Cobalt, in connection with which litigation has recently been settled, leaving open the way to active resumption of operations. By conservative engineers it is estimated to contain several thousand tons of comparatively high-grade ore.

The meeting of the shareholders of the Trethewey-Cobalt company, held January 30 in Toronto, endorsed the agreement recently entered into by the directors authorizing the sale of the Cobalt mine of the Trethewey company to, the Coniagas Mines, Ltd., the price being \$100,000. The Trethewey retains a few extra mill parts for possible use at its Castle properties in the Gowganda district.

The Mining Corporation, in addition to its usual activity in searching for prospective mines, during the coming spring will carry out considerable exploration work on claims which the company acquired last fall in the township of Butt, the object being exploration for radium-bearing ore. Butt township is situated in the Nipissing district, south from North Bay, and about 150 miles from Cobalt. The erection of a 300-ton flotation plant on the Chambers-Ferland property is being considered, following the sampling of the tailing pile, by Toronto people who have for some weeks held an option to purchase the tailing.

At the 530-ft. level of the Beaver mine the new body of silver ore opened up early in the year has been found to be ten feet wide in places, the enrichment extending several feet back in the walls beyond the vein proper.

A new explosive, known as 'Thompsonite', is soon to be placed on the market at Cobalt, the head office and plant of the new concern being situated at Desoronto, Ontario. In a statement just sent out, the new explosive is referred to optimistically by the managers of the Beaver, Temiskaming, and Bourke's mines.

PORCUPINE.—The mines are steadily increasing their output as the influx of laborers has enabled them to take on more men. The Dome Mines is now treating about 1000 tons per day and is said to have succeeded in reducing working costs to about \$3 per ton. The workmen are preparing to make a demand before long for a substantial increase in wages, which are considerably below those paid at Cobalt. At present the Porcupine miners receive \$4 per day and upward, which is about \$1 less than the Cobalt scale including the bonus based on the selling price of silver. A decline in the price of silver to between 90c. and \$1 per ounce would make the wage scales about even. The Porcupine men emphasize the improbability of such a downward movement, and the demand for a readjustment is scheduled to take a definite shape in the early spring. So far there has been no indication of what action will be taken by the mining companies.

KIRKLAND LAKE.—At the Kirkland Lake mine the deposit of rich ore which is being developed has been found to be considerably larger than was previously known, drifts on the 400 and 500-ft. level having been extended. The orebody, about 5 ft. wide, maintains its grade, and

development work will be continued on the 600 and 700-ft. levels. The Lake Shore is on a normal basis of operation and work has been resumed at the 400-ft. level. The Wood-Kirkland has been organized with a capitalization of \$2,000,000, and has secured about 300 acres in this district, on which work will shortly be begun. The financial statement presented at the annual meeting of the Tough-Oakes showed a net loss for the year of \$105,934 owing to the interruption of operations by the miners' strike. Col. H. H. Johnson, general manager, now in Rhodesia, is expected to return in March, when it is proposed to resume operations.

LARDER LAKE.—The Associated Gold Fields reports that the opening up of Block 'C' has proved highly satisfactory. Diamond-drilling and underground workings at regular intervals for a length of 3500 ft. show that the orebody is nowhere less than 400 ft. wide, reaching to a width of 500 ft. in some places. Its known length on the company's properties is over one mile. Work is being pushed to enable the engineers to estimate the total gold content. On Block 'B' much free gold has been found in cross-cutting at the 400-ft. level. The company has now 150 men on the payroll and is increasing its force.

SONORA

RICH ORE AT NORTH TIGRE.—MILL AT ROY TO BE STARTED AGAIN.

NORTH TIGRE.—A five-foot vein of ore carrying a rich streak highly impregnated with native silver, assaying as high as 2000 oz. per ton, has been cut on the eighth level of this property operated by the North Tigre Leasing company. This is the richest ore yet found in the property, which is under lease to a group of Bisbee and Douglas people for a period of two and a half years. A 50-ton mill which has been in course of erection for several weeks is expected to make its first run about March 1. Approximately one and a quarter million dollars worth of ore has been blocked out in the workings, it is stated by the management. Frank J. Holmes, manager of the property, is superintending construction of the mill and breaking ore preparatory to starting the plant, which will include flotation and table concentration processes.

BIG FOUR.—John Hohstadt has let a contract to Macaro Alatore to run a tunnel 300 ft. on his Big Four property, approximately four miles from El Tigre. This is virgin ground, but it is Mr. Hohstadt's expectation that he will be able to develop a large vein of silver-gold-lead ore which crops out at the surface. The tunnel is expected to cut the vein a considerable distance below the surface.

ROY.—W. R. Maycumber, mill superintendent for the Roy mine at Pilaes de Teras, recently purchased a large gasoline engine in Douglas to be used in operating the 50-ton flotation plant. Upon test runs made recently the mill was found to work well and make good recovery, but the engine was too small to operate the plant successfully. With the larger engine in place Mr. Maycumber believes the last obstacle to placing the Roy in the list of steady producers will have been removed. The property has large reserves of silver ore developed.



ARIZONA

Jerome.—Work on the new tunnel of the Shea mine is expected to commence February 1. A new road to the Shea camp has been completed. A compressor and electrical equipment for the same are to be installed at the portal immediately.

Kingman.—Messrs. Fay and Schoenmehl announced on their arrival at Kingman that sinking operations at the Bella Union mine are to be resumed immediately. The present shaft which is 125 ft. deep will be sunk to the 500-ft. level at which point drifting is to be done.—Machinery is now being installed in the Dean mill. The late storms have delayed construction. The capacity of the plant will be 40 tons per day.—Re-timbering of the shaft at the Dalsell mine has been completed and sinking commenced at the 300-ft. level. This level is to be cleaned and drifting started. To meet the increased power requirements a 40-hp. Fairbanks-Morse engine has been ordered.

Miami.—The Van Dyke Copper Co. is to increase its sinking operations immediately. The single shift now working is to be increased to three shifts. The shaft is planned to go from the 600 to the 1500-ft. level.

Patagonia.—Messrs. Brown and Reed of the Flux Mining Co. have gone to Courtland to arrange the shipment of engine, compressor, drills, and miscellaneous machinery recently purchased.

Phoenix.—The Pluma Kings Mining Co. operating in the Vulture district for the past two years has opened paying lead, gold, and silver ore. The company intends to install equipment for larger development.

Tucson.—The San Xavier Copper Co. recently cut high-grade copper-silver ore in sinking the main shaft. Samples are said to run 12% copper and 15 oz. in silver. Ralph W. Langworthy who holds notes against the Mile Wide Copper Co. has made application in the Superior Court for the appointment of a receiver.

CALIFORNIA

Bakersfield.—The State Range Minerals Co. of Bakersfield, with mines in the State Range, has lately constructed a complete 50-ton milling-plant. Standard ball-mills, a gyratory crusher, two Overstrom concentrating tables, and K. & K. flotation machines are included in the equipment. Heretofore the ores from the mines have been shipped to the U. S. Smelting, Refining & Mining Co. at Salt Lake City. The ore averages \$35 per ton in silver, lead, and gold.

Redding.—The Noble Electric Steel Co. is shipping two carloads of iron per month from Heroult to various iron works in the State. Thirty-three carloads have been shipped since last July, the ore containing 65% iron.

COLORADO

La Plata.—J. H. Avery is shipping from the Idaho dumps and has good ore, assaying \$50 per ton in gold.

Ouray.—The rich silver-copper ore recently found on the Early Bird group is said to assay 30% copper in a 3-ft. vein. The tunnel is now in a distance of 170 ft., and the vein is widening. A pack train of 18 horses is hauling the ore to the railroads, and the force of miners is being increased to

thirty.—Luna & Eckman are shipping steadily from the Wedge, having opened up high-grade silver ore averaging \$200 per ton.

Telluride.—The Tomboy Gold Mines Co. is having some difficulty in making the desired separation of zinc, but the new milling process is giving a highly satisfactory recovery.

The Liberty Bell Gold Mining Co. has decided to continue operations, this decision being arrived at after a re-survey of the old vein. As the company had definitely decided to close down on February 1, all power contracts were dissolved, with the result that milling operations will not be resumed until such time as more power is available.

IDAHO

Coeur d'Alene.—The width of the new orebody in the property of the Consolidated Interstate-Callahan company, at Wallace, has widened to 22 ft. While generally referred to as 'new' this orebody is regarded as the continuance of a shoot that disappeared at a fault a year ago. The average content of the ore throughout its 22 ft. of width is 23.7% zinc, 12.8% lead, and 4 oz. of silver per ton, according to report.

MONTANA

Anaconda.—The fertilizer-plant, now under construction for the Anaconda company, at a cost of \$75,000, will have an initial capacity for the treatment of 50 tons of phosphate rock daily, but this will be increased to 1000 tons daily before the conclusion of the year. The company's product is known as a 'double acid' fertilizer and will contain about 80% phosphoric acid.

Butte.—The cross-cut on the 2700-ft. level of the Colorado mine of the Davis-Daly Copper Co. is cutting a number of high-grade stringers of glance and bornite ore, indicating a continuance of the mineralization.

Figures for January show that the North Butte company produced approximately 2,000,000 lb. of copper. This is almost three times December's output, when, owing to the incipient strike of soft-coal miners, the mines and smelters of Anaconda were compelled to close down. Ground now being passed through gives every indication that the Edith May vein will be cut on the 3400-ft. level. In this event, the next step will be to open another level 200 ft. below.

NEVADA

Tonopah.—It is reported that 60% of the miners at Tonopah have walked out following the refusal of the companies to continue the bonus of 50c. per day. About 600 men are affected.

The decision of most of the Divide companies not to cancel the bonus, marks a serious split in the ranks of the mine operators. Reports are current that several Tonopah operators plan to meet the demands of the men and restore the bonus as a flat wage increase.

UTAH

Park City.—For the week ending January 31, eight mines in this district shipped 2324 tons of ore, as compared with 2344 tons for the previous week. Of this tonnage, the Ontario shipped 757 tons; Silver King Coalition, 518 tons; Judge Mining & Smelting, 534 tons; Daly-West, 119 tons; Daly Mining, 110 tons; Naildriver, 165 tons; Silver King Consolidated, 110 tons; and the New Quincy, 11 tons.

STATEMENT BY MR. HOOVER

On January 8 Mr. Hoover issued the following statement in New York.

In order to answer a large number of questions all at once, let me emphasize that I have taken a day off from the industrial conference in Washington to come to New York solely to attend to pressing matters in connection with the children's relief. I want to say again: I have not sought and am not seeking the Presidency. I am not a candidate; I have no 'organization'. No one is authorized to speak for me politically.

As an American citizen by birth and of long ancestry, I am naturally deeply interested in the present critical situation. My sincere and only political desire is that one or both of the great political parties will approach the vital issues, which have grown out of the War and are new, with a clear purpose looking to the welfare of our people and that candidates capable of carrying out this work should be nominated.

If the treaty goes over to the Presidential election (with any reservations necessary to clarify the world's mind that there can be no infringement of the safeguards provided by our Constitution and our nation-old traditions) then I must vote for the party that stands for the league.

With it there is hope, not only of the prevention of war, but also that we can safely economize in military policies. There is hope of earlier return of confidence and the economic reconstruction of the world. I could not vote with a party if it were dominated by groups who seek to set aside our constitutional guarantees for free speech or free representation, who hope to re-establish control of the Government for profit and privilege.

I could not vote with a party if it were dominated by groups who hope for any form of socialism, whether it be nationalization of industry or other destruction of individual initiative. Both these extremes, camouflaged or open, are active enough in the country today. Neither of the dominations would enable those constructive economic policies that will get us down from the unsound economic practices which of necessity grew out of the War, nor would they secure the good will to production in our farmers and workers or maintain the initiative of our business men. The issues look forward, not backward.

I do not believe in more than two great parties. Otherwise, combinations of groups could, as in Europe, create a danger of minority rule. I do believe in party organization to support great ideals and to carry great issues and consistent policies. Nor can any one man dictate the issues of great parties. It appears to me that the hope of a great majority of our citizens in confronting this new period in American life is that the great parties will take positive stands on the many issues that confront us, and will select men whose character and associations will guarantee their pledges.

I am being urged by people in both parties to declare my allegiance to either one or the other. Those who know me, know that I am able to make up my mind when a subject is clearly defined. Consequently, until it more definitely appears what the party managers stand for, I must exercise a prerogative of American citizenship and decline to pledge my vote blindfold.

I am not unappreciative of the many kind things that my friends have advanced on my behalf. Yet, I hope they will realize my sincerity in not tying myself to undefined partisanship.

LOCAL SECTION A. I. M. & M. E.

The next meeting of the San Francisco Section will be held at the Engineers Club on February 24. Edwin Higgins will read a paper on 'The Human Element in Mining'. A number of engineers have been invited to take part in the discussion, which promises to be interesting and useful.

Personal

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. Erb Wuensch, of Golden, Colorado, is in New York.

G. W. Wood, manager for the Sunset Mining Co., at Leadore, Idaho, is at Salt Lake City.

S. M. Soupcoff, mining engineer of the Utah Department of the A. S. & R. Co., has returned to Salt Lake City after a trip to Arizona.

J. C. Ray has returned to Palo Alto from the Rice Lake gold-mining district in Manitoba and expects to go to New York this week.

Clarence Clyde has returned to San Francisco from Siam. While in the Malay States he met C. H. Munro, whom he reports well and cheerful.

J. Mackintosh Bell has returned to Almonte, Ontario, from Cambridge, where he delivered a course of geological lectures at Harvard University.

Sidney J. Jennings, vice-president of the U. S. Smelting, Refining & Mining Co., passed through San Francisco last week on his way from Utah to Arizona.

George A. Packard, of Boston, passed through San Francisco last week. He is examining mines in Nevada, California, and Arizona, and will return to Boston about March 15.

C. R. McCollom has lately returned from Army service in France, and has opened an office in the Consolidated Realty Bdg., Los Angeles, for the resumption of practice as mining engineer and field geologist.

H. C. Smith, who has been connected with the Utah Copper Co. for the past 14 years, the last six years being in the capacity of superintendent of the Magna plant at Garfield, has been promoted to the position of superintendent of mills for the Ray Consolidated Copper Co. at Hayden, Arizona.

Hjabmar E. Skougo, has recently severed his connection with the Guggenheim Brothers, Chile Exploration Co., and Braden Copper Co., with whom he has been connected as their designing engineer for the past seven years, and has returned to private practice as consulting industrial engineer.

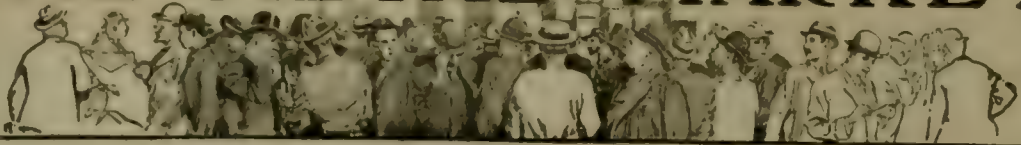
Obituary

Robert Hay Anderson died in Mexico City on December 23, 1919, at the age of 48. He was a Scot by birth and had spent most of his life as a mining engineer in Mexico. We record his death with deep regret, for he was a man of many engaging qualities and the most sterling character.

Alfred H. Peabody, age 54, died at his home in Salt Lake City on January 29, following a three days' illness of influenza-pneumonia. He was widely known in Utah, being secretary of the Judge Mining & Smelting Co., the Daly-West Mining Co., and the Park-Utah Mining Co., all in the Park City district. He was a talented musician, being organist at St. Marks Episcopal Cathedral and also at the Masonic Temple. He is survived by a wife and two sons.

J. T. Hillis, one of the best known mining men in British Columbia, died recently. He came to the Province in 1900 from Montana and was one of the first interested in what is now the Britannia mine, on Howe Sound. Subsequently he became identified with the group of claims at Hidden Creek, which later developed into the Hidden Creek mines, operated by the Anxox branch of the Granby Consolidated Mining & Smelting Company.

THE METAL MARKET



METAL PRICES

San Francisco, February 10

Aluminum dust, cents per pound.....	65
Antimony, cents per pound.....	12.00
Copper, electrolytic, cents per pound.....	10.25
Lead pig, cents per pound.....	9.00-10.00
Platinum, pure, per ounce.....	\$155
Platinum, 10% iridium, per ounce.....	\$180
Quicksilver, per flask of 75 lb.....	\$80
Spelter, cents per pound.....	10.50
Zinc dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

February 9—Copper is dull and easier. Lead is quiet and steady. Zinc is inactive and lower.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½, on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.85 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York			London			Average week ending		
cents			pence			Cents		
Feb. 3.....	133.25		86.00			Dec. 30.....	132.50	78.87
" 4.....	132.75		86.25			Jan. 6.....	130.80	78.19
" 5.....	132.00		86.37			" 13.....	133.71	79.49
" 6.....	132.00		88.00			" 20.....	132.04	78.81
" 7.....	132.50		88.00			" 26.....	132.58	80.00
" 8 Sunday.....						Feb. 2.....	134.37	83.83
" 9.....	133.00		88.50			" 9.....	132.50	87.69

Monthly averages			1918			1919		
			1918			1919		
Jan.	88.72	101.12	132.77	July	89.62	106.36	....	....
Feb.	85.79	101.12	....	Aug.	100.31	111.35	....	....
Mch.	88.11	101.12	....	Sept.	101.12	113.92	....	....
Apr.	95.35	101.12	....	Oct.	101.12	119.10	....	....
May	99.50	107.23	....	Nov.	101.12	127.57	....	....
June	99.50	110.50	....	Dec.	101.12	131.92	....	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date			Average week ending		
Feb. 3.....	19.25		Dec. 30.....	18.92	
" 4.....	19.25		Jan. 6.....	19.25	
" 5.....	19.12		" 13.....	19.50	
" 6.....	19.12		" 20.....	19.16	
" 7.....	19.00		" 26.....	19.08	
" 8 Sunday.....			Feb. 2.....	19.23	
" 9.....	19.00		" 9.....	19.12	

Monthly averages			1918			1919		
			1918			1919		
Jan.	23.50	20.43	19.25	July	26.00	20.82	....	....
Feb.	23.50	17.34	....	Aug.	26.00	22.51	....	....
Mch.	23.50	15.05	....	Sept.	26.00	22.10	....	....
Apr.	23.50	15.23	....	Oct.	26.00	21.68	....	....
May	23.50	15.91	....	Nov.	26.00	20.45	....	....
June	23.50	17.53	....	Dec.	26.00	18.55	....	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending		
Feb. 3.....	8.75		Dec. 30.....	7.53	
" 4.....	8.75		Jan. 6.....	8.05	
" 5.....	8.75		" 13.....	8.73	
" 6.....	8.75		" 20.....	8.75	
" 7.....	8.75		" 26.....	8.75	
" 8 Sunday.....			Feb. 2.....	8.75	
" 9.....	8.75		" 9.....	8.75	

Monthly averages			1918			1919		
			1918			1919		
Jan.	8.85	5.60	8.65	July	8.03	5.53	....	....
Feb.	7.07	5.13	....	Aug.	8.05	5.78	....	....
Mch.	7.26	5.24	....	Sept.	8.05	6.02	....	....
Apr.	6.99	5.05	....	Oct.	8.05	6.40	....	....
May	6.88	5.04	....	Nov.	8.05	6.78	....	....
June	7.59	5.32	....	Dec.	6.90	7.12	....	....

TIN

Prices in New York, in cents per pound:

Monthly averages			1918			1919		
			1918			1919		
Jan.	85.13	71.50	62.74	July	93.00	70.11	....	....
Feb.	85.00	72.44	....	Aug.	91.33	62.20	....	....
Mch.	85.00	72.50	....	Sept.	80.40	55.79	....	....
Apr.	88.53	72.50	....	Oct.	78.82	54.82	....	....
May	100.01	72.50	....	Nov.	73.67	54.17	....	....
June	91.00	71.83	....	Dec.	71.52	54.94	....	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date			Average week ending		
Feb. 3.....	9.35		Dec. 30.....	8.90	
" 4.....	9.25		Jan. 6.....	9.42	
" 5.....	9.00		" 13.....	9.75	
" 6.....	8.97		" 20.....	9.50	
" 7.....	8.95		" 26.....	9.54	
" 8 Sunday.....			Feb. 2.....	9.41	
" 9.....	8.90		" 9.....	9.07	

Monthly averages

1918			1919			1920		
Jan.	7.78	7.44	9.56	July	8.72	7.78	....	....
Feb.	7.97	6.71	....	Aug.	8.78	7.81	....	....
Mch.	7.67	6.53	....	Sept.	9.58	7.57	....	....
Apr.	7.04	6.49	....	Oct.	9.11	7.82	....	....
May	7.92	6.43	....	Nov.	8.75	8.12	....	....
June	7.92	6.61	....	Dec.	8.49	8.39	....	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			Average week ending		
Jan. 13.....	90.00		Jan. 27.....	90.00	
" 20.....	90.00		Feb. 3.....	85.00	
			" 10.....	80.00	

Monthly averages			1918			1919		
Jan.	128.00	103.75	89.00	July	120.00	100.00	....	....
Feb.	118.00	90.00	....	Aug.	120.00	103.00	....	....
Mch.	112.00	72.80	....	Sept.	120.00	102.00	....	....
Apr.	115.00	73.12	....	Oct.	120.00	80.00	....	....
May	110.00	84.80	....	Nov.	120.00	78.00	....	....
June	112.00	84.40	....	Dec.	115.00	95.00	....	....

MONEY AND EXCHANGE

Prospects of falling prices are discussed by the National Bank of Commerce in New York in the February number of 'Commerce Monthly'. The bank's publication, just issued. The bank, while not predicting a definite time when price adjustment may be expected, maintains that the process need not mean disruption to business.

"If, when the tide turns," says the bank, "readjustment is not too long resisted and production is not too much slowed down, and if the situation is flexible and competitive, we may expect to meet the reaction without disaster. The country is not as well braced now for reaction as it was at the time of the Armistice, but so many of our major industries are in an exceedingly strong position, and our banks are as a whole in such excellent condition, that we should view the prospect without undue apprehension. The question of price readjustment in the United States is tied up with our attitude toward Europe's economic recovery. If it is felt that we are all involved to a significant degree in a common economic future, our participation will doubtless be active. As a part of such a policy, new loans to Europe to make possible a continuance of our exports essential to reconstruction would delay the process of price readjustment.

"Withdrawal of the present extensions of credit to support exports to Europe would soon check the present abnormally one-sided trade. This would necessitate our domestic market's absorbing three or four hundred million dollars worth of goods each month which our market has not had to absorb during 1919. With goods thrown back on the domestic market in this volume a relaxation of the strain in our commodity markets would follow. Two possibilities would then be opened. On the one hand, we might have a speedy readjustment of prices and wages and a revival of business activity on a lower level. On the other hand, if efforts were made to resist price reduction by artificial means, we would be exposed to the dangers of a painful period of real business depression.

"When this readjustment comes, the business men of the country will have opportunity for a policy toward labor which will go far in making for industrial peace in the years that follow. In so far as balance-sheets permit it, business men will find it wise to let prices go down first without making too vigorous efforts to reduce wages. The natural course of events will lead to substantial wage reductions in time. However, we cannot expect to see wages recede as rapidly or as far as prices, because the elimination of immigration in recent years has left our labor supply relatively short. Even without reduction in wages, labor costs per unit of output will be reduced with the restoration of shop discipline and the cessation of overtime work.

"The great change in prices in the United States has been due, not to a fall in the value of gold, but to a rise in the value of goods. At the present time forces are at work tending to make the value of gold rise rather than fall. High prices and high wages are curtailing gold production, and with diminished production there has come also an increased industrial consumption of gold. At the present time the arts and industries are consuming more gold in the United States than our gold mines are producing. If no other factor were at work, this would mean in the long run a fall in prices."

Foreign quotations on February 10 are as follows:

Sterling, dollars: Cable	3.36%
" Demand	3.35%
Francs, cents: Cable	6.91
" Demand	6.90
Lire, cents: Demand	3.49
Marks, cents	1.15

Eastern Metal Market

New York, February 4.

The markets are all quiet but prices are firm in most cases. The very low levels to which foreign exchange has fallen is the predominating influence.

Copper buying has fallen off but prices remain steady.

Tin values have fluctuated with that of the pound sterling and have declined decidedly.

The lead market is quiet but still strong.

Demand for zinc is light and prices are slightly easier.

Antimony remains strong.

IRON AND STEEL

A serious car shortage is one of the predominating factors confronting the steel industry today. Its seriousness can hardly be overestimated. Inadequate coal and coke supplies have forced the banking of more blast-furnaces and 50,000 tons of finished steel is piled at the leading interest's yards in Chicago waiting for cars, and an Eastern company has stored 30,000 tons of structural steel alone. At least 25% of the foundries in the Cleveland district are shut down partly or wholly because of a lack of fuel.

Many iron and steel producers have withdrawn from the market. In Chicago the leading interest has no shapes, plates, or bars to sell, nor rails or track supplies. Some pig-iron makers will book nothing further for 1920. Pig-iron sales have been very large.

The January pig-iron output, despite adverse railroad conditions, was better than any month since March 1919. The output, according to 'The Iron Age's' monthly report, was 3,015,181 gross tons as compared with 2,633,268 tons in December, both 31-day months. The daily January average was 97,264 tons or 14½% more than in December, which averaged 84,944 tons per day.

The Steel Corporation's advance in wages of 10%, announced a few days ago, has hardly caused a ripple in the steel market as \$1.50 to \$2 more per ton would probably balance the increased outgo.

COPPER

Demand is reported to have slackened considerably. It is even stated that some inquiries have been withdrawn from the market. Prices continue fairly firm with leading producers and most of the small ones quoting 19.25c., New York, for electrolytic for early delivery, with Lake held at 19.50c. The erratic and low values of exchange have interfered with any foreign business that might be possible and not much buying for foreign consumption is looked for until exchange values are more stable. For second quarter delivery for domestic consumption, values are about 19.50c., New York, for electrolytic and 19.75c. for Lake.

TIN

The market has been almost completely controlled by the value of the pound sterling which has fallen daily to the lowest levels on record. Because of this, spot Straits has also declined each day until yesterday it was quoted at 59c., New York. This is a fall of 3.25c. per pound in the week. The decline in London has not been as heavy. Yesterday spot Straits was quoted at £386 5s. per ton, as compared with £393 a week ago. The market has been very quiet with but little business reported, most of it having been between traders. Consumers are naturally waiting developments. In future shipments, little also has been done, there being little desire by sellers to do business for this position. Quotations for this delivery are about ½ to 1c. above those for spot shipment. Deliveries of tin into consumption were 3910 tons in January, of which 910 tons are credited to Pacific ports. In stock and landing on January 31 there were 3723 tons. Tin afloat is reported as 5030 tons.

LEAD

The amount of lead available seems to be nearly equal to the demand which has been light. The market continues strong with prices firm at 8.75c., New York, and 8.45c., St. Louis, for early delivery. Spot delivery is available at 8.75 to 8.87½c., New York, at which prices some business has been done. Production is reported to be improving.

ZINC

The market has turned quiet and almost stagnant. While the drop in foreign exchange has not had the effect in this market as in some of the others, it has been a factor. This decline has been offset to some extent by progressive advances in the price of zinc in London. Domestic demand here has fallen off some, though it has been fairly good. Consumers, however, are in general inclined to wait developments. Prime Western for early delivery is now quoted at 9c., St. Louis, or 9.35c., New York, and these prices are fairly firm despite general conditions. Foreign sales and demand are a minor matter under the circumstances.

ANTIMONY

Demand is good and the market is strong at 11.25c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, are quoted at 31.50 to 32.50c., New York, for early delivery.

ORES

Tungsten: The market is marking time pending some decision as to a tariff. Inquiry is light and prices are nominal at \$6 to \$15 per unit, depending on the grade. Ferro-tungsten is quoted by one authority at about \$1 per lb. of contained tungsten.

Molybdenum: Quotations are unchanged and nominal at 75c. per lb. of MoS₂ in regular concentrates.

Manganese-Iron Alloys: Ferro-manganese for spot delivery has sold as high as \$185, delivered, and is very scarce. Very little alloy is available for first half, most of the British alloy offered for delivery from April and May on, having been sold at \$145 to \$150, seaboard. About 4000 tons has been sold. American producers are asking \$160, delivered, for second half and it is said some sales have been made.

In 1913, writes H. M. Ridge in 'The Journal of the Society of Chemical Industry', the world's spelter production amounted to 982,000 tons, of which 32% was made in the United States, 28% in Germany, and 20% in Belgium; In Great Britain only 6% was made, although the consumption amounted to 23% of the metal produced in the whole world, while in the whole of the rest of the Empire only 3700 tons was produced. As a consequence an acute shortage of metal was experienced during the War and prices rose phenomenally. Schemes were prepared for increasing the output, but with the whole of the smelting capacity of the United Kingdom in operation only 80,000 to 85,000 tons could now be produced annually. For the ten years before the War the average price of g.o.b. spelter in London was £23 16s.5d. Since then the average prices have been:

1914	.....£23	6	8	1917	.....£52	3	6		
1915	.....	66	13	8	1918	.....	52	4	0
1916	.....	68	18	11	1919	.....	42	5	3

At the present time production is progressing satisfactorily in America, but Belgium is producing only 6500 tons per month, or 39% of the pre-war output, and Germany 3500 tons, or 14%, and Great Britain 2000 tons, or 40%. It is obvious that until conditions improve we are dependent on American supplies.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1919	Total	Latest dividends	
						Date	Per share
Ahmsek, Michigan	copper	200,000	\$25.00	600,000	11,850,000	Dec. 31, 1919	\$1.00
Allouez, Michigan	copper	100,000	25.00	100,000	2,850,000	Feb. 31, 1919	1.00
American S. & R. U. S. and Mex.	copper	600,000 (com.)	100.00	2,430,000	11,312,000	Dec. 15, 1919	1.00
		500,000 (pfd.)	100.00	3,500,000	com. and pfd.	Dec. 15, 1919	1.75
Am. Z. L. & S. Missouri and Tenn.	copper	1,193,120 (com.)	25.00				
		96,500 (pfd.)	25.00	482,037	5,613,620	Nov. 1, 1919	1.50
Anasconda, Montana	copper	2,331,250	50.00	10,400,025	165,448,125	Nov. 24, 1919	1.00
Argonaut, California	gold	200,000	5.00	80,000	1,070,000	Dec. 25, 1919	0.05
Atolla, California	tungsten	100,000	1.00		5,264,500	Dec. 14, 1918	0.50
Arizona, Arizona	copper	1,519,800	5s	227,000	2,713,728	Aug. 31, 1919	0.18
		1,316,530	7% pfd.	53,840	21,480,004	Nov. 21, 1919	
Arizona Commercial, Arizona	copper	205,000	5.00		1,080,500	Oct. 31, 1918	0.50
Barnes-King, Montana	gold	400,000	5.00	120,000	3,800,000	Nov. 15, 1919	0.05
Bingham Mines, Utah	silver	150,000	10.00	112,500	600,000	Sept. 30, 1919	0.25
Bunker Hill & Sullivan, Idaho	silver	327,000	10.00	1,144,500	23,231,250	Dec. 4, 1919	0.50
Butte & Superior, Montana	zinc	200,184	10.00		16,040,258	Sept. 1, 1917	1.25
Butte Copper & Zinc, Montana	zinc	411,700	5.00		205,800	July 30, 1918	0.50
Caledonia, Idaho	silver	2,005,000	1.00	312,000	4,021,750	Dec. 5, 1919	0.01
Calumet & Arizona, Arizona	copper	942,521	10.00	1,927,563	43,060,387	Dec. 22, 1919	0.50
Calumet & Hecla, Michigan	copper	100,000	25.00	1,000,000	151,750,000	Dec. 31, 1919	5.00
Centennial, Michigan	copper	90,000	25.00		360,000	Dec. 31, 1918	1.00
Cerro Gordo, California	silver	1,000,000	1.00		299,275	Jan. 15, 1918	0.05
Champion, Michigan	copper	100,000	25.00	1,280,000	25,250,241	Dec. 15, 1919	0.64
Chief Con., Utah	silver	884,232	1.00	282,954	1,517,825	Nov. 1, 1919	0.06 1/2
Chino, New Mexico	copper	869,980	5.00	2,609,940	29,012,982	Dec. 31, 1919	0.75
Columbus-Rexall, Utah	silver	586,234	1.00	14,600		Jan. 15, 1919	0.02 1/2
Con. Arizona Smelting, Arizona	copper	1,863,000	5.00		498,900	Dec. 17, 1918	0.05
Con. Interstate-Callahan, Idaho	zinc	325,000	10.00		6,966,082	Oct. 21, 1918	0.75
Copper Range, Michigan	copper	395,000	25.00	986,016	26,406,720	Dec. 15, 1919	0.50
Cresson, Colorado	gold	1,220,000	1.00	1,220,000	8,369,143	Dec. 10, 1919	0.10
Daly, Utah	silver	150,000	20.00	97,500	3,125,000	Oct. 1, 1919	0.10
Davis-Daly, Montana	copper	600,000	10.00	300,000	750,000	Dec. 20, 1919	0.50
Dragon Con., Utah	silver	1,875,000	1.00		150,000	Oct. 1, 1918	0.01
Ducktown, Tennessee	copper	198,000	4.80		2,678,702	May 1, 1917	0.86
Eagle & Blue Bell, Utah	silver	893,146	1.00	89,315	1,250,405	Sept. 1, 1919	0.05
East Butte, Montana	copper	421,849	10.00	210,924	1,687,396	Dec. 31, 1919	0.50
Electric Point, Washington	lead	793,750	1.00	47,625	301,625	Dec. 22, 1919	0.03
Empire, Idaho	copper	1,000,000	1.00		880,000	July 1, 1918	0.05
Enola, California	copper	1,791,826	1.00		565,273	Oct. 1, 1918	0.01 1/2
Federal M. & S., Idaho	silver	120,000	100.00	240,000	15,004,350	Dec. 14, 1919	0.50
First National Copper Co., Cal.	copper	800,000	5.00	80,000	660,000	Feb. 25, 1919	0.15
General Development, U. S.		120,000	25.00		4,813,917	Sept. 3, 1918	1.00
Golden Cycle, Colorado	gold	1,500,000	1.00	540,000	9,238,500	Dec. 10, 1919	0.03
Grand Central, Utah	silver	600,000	1.00	36,000	1,858,000	Dec. 23, 1919	0.02
Hecla, Idaho	silver	1,000,000	0.25	600,000	7,855,000	Dec. 28, 1919	0.15
Homestake, South Dakota	gold	251,180	100.00	879,080	43,050,244	Sept. 25, 1919	0.50
Inspiration, Arizona	copper	1,181,987	20.00	7,682,786	33,078,866	Oct. 28, 1919	1.50
Iron Blossom, Utah	silver	1,000,000	0.10	75,000	3,250,000	Dec. 25, 1919	0.02 1/2
Iron Cap, Arizona	copper	142,100	10.00	72,942	960,778	Feb. 15, 1919	0.25
Ile Royale, Michigan	copper	150,000	25.00	150,000	2,025,000	Sept. 30, 1919	0.50
Jim Butler, Nevada	silver	1,718,021	1.00		1,151,074	Aug. 1, 1918	0.07
Judge M. & S., Utah	silver	480,000	1.00	60,000	2,370,000	April 1, 1919	0.12 1/2
Kennecott, Alaska	copper	2,786,879	5.00	5,573,261	47,930,258	Dec. 30, 1919	0.50
Liberty Bell, Colorado	gold	133,560	5.00	66,778	2,660,959	Dec. 31, 1919	0.10
Lucky Taker, Sonora, Mexico	silver	715,337	10.00	1,158,846	6,146,199	Dec. 20, 1919	0.30
Magma, Arizona	copper	240,000	5.00	120,000	1,704,000	Jan. 6, 1919	0.50
Mass Con., Michigan	copper	100,000	25.00		500,000	Aug. 15, 1917	1.00
Miami Copper Co., Arizona	copper	747,114	5.00	1,867,785	21,482,829	Nov. 15, 1919	0.50
Mohawk, Michigan	copper	100,000	25.00	500,000	9,125,000	Nov. 1, 1919	1.00
Nevada Con., Nevada	copper	1,999,457	5.00	2,999,186	45,269,024	Dec. 31, 1919	0.37 1/2
Nevada Packard, Nevada	silver	1,164,492	1.00	23,290	110,627	April 20, 1919	0.02
Nevada Wonder, Nevada	silver	1,500,000	1.00	70,424	1,519,005	May 21, 1919	0.05
New Cornelia, Arizona	copper	1,800,000	5.00		450,000	Nov. 25, 1918	0.25
New Idria, California	quicksilver	100,000	5.00	25,000	2,705,000	Jan. 1, 1919	0.25
New Jersey Zinc, New Jersey	zinc	350,000	100.00	7,000,000		Dec. 10, 1919	2.00
North Butte, Montana	copper	430,000	15.00		14,637,000	Oct. 28, 1918	0.25
North Star, California	gold	250,000	10.00	100,000	5,537,040	June 28, 1919	0.40
Old Dominion, Arizona	copper	297,071	25.00		14,405,280	Dec. 31, 1918	1.00
Ontario Silver, Utah	silver	150,000	100.00	75,000	14,157,300	Jan. 4, 1919	0.50
Oscoda, Michigan	copper	96,150	25.00	288,450	17,660,225	Dec. 31, 1919	1.00
Phelps Dodge, Ariz., N. Mex., Mex.	copper	450,000	100.00	4,500,000	84,596,527	Oct. 2, 1919	2.50
Portland, Colorado	gold	3,000,000	1.00	240,000	11,497,080	Oct. 20, 1919	0.02
Quincy, Michigan	copper	110,000	25.00	440,000	26,892,500	Dec. 22, 1919	1.00
Ray Con., Arizona	copper	1,577,179	10.00	3,154,361	23,835,430	Dec. 31, 1919	0.50
Rochester Mines, Nevada	silver	2,210,591	1.00		88,064	Oct. 1, 1918	0.02 1/2
Shannon, Arizona	copper	300,000	10.00		1,425,000	Nov. 15, 1917	0.25
Shattuck, Arizona	copper	350,000	10.00	437,500	7,523,000	Oct. 20, 1919	0.25
Silver King Coalition, Utah	silver	1,250,000	5.00		15,198,560	Jan. 1, 1918	0.15
Silver King Con., Utah	silver	850,537	1.00		1,562,705	April 1, 1918	0.10
St. Joe Lead, Missouri	lead	1,409,466	10.00	1,550,413	19,570,374	Dec. 20, 1919	0.25
Tamarrack & Custer, Idaho	silver	1,776,500	1.00		461,830	Aug. 27, 1918	0.06
Tennessee Copper, Tennessee	copper and acid	391,198	no par value		392,817	May 15, 1918	1.00
Tintie Standard, Utah	silver	1,171,500	1.00	552,109	950,982	Dec. 24, 1919	0.23
Tomboy, Colorado	silver	310,000	\$1		4,074,200	June 28, 1918	0.12
Tom Reed, Arizona	gold	909,555	1.00	218,293	2,755,952	Dec. 20, 1919	0.02

*Of this sum, \$1,652,260 was paid by the individual companies prior to their amalgamation in 1914.

†This is a capital distribution, and reduces the par value of the stock from \$5 to \$4, corresponding to a reduction in total capitalization from \$3,000,000 to \$2,400,000.

Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid in 1919	Total	Latest dividends	
						Date	Per share
Tonopah Belmont, Nevada	s.g.	1,500,000	1.00	375,000	10,043,063	Oct. 1, 1919.....	0.05
Tonopah Extension, Nevada	s.g.	1,282,801	1.00	448,980	2,361,379	Oct. 16, 1919.....	0.10
Tonopah Mining, Nevada	s.g.	1,000,000	1.00	300,000	14,875,000	Nov. 21, 1919.....	0.15
United Eastern, Arizona	gold	1,363,000	1.00	899,580	2,153,540	Oct. 28, 1919.....	0.07
U S S. R. & M., U. S., Mexico....	l.z.c.s.g.	ptd. 486,350	50.00	1,702,235	23,179,042	Oct. 15, 1919.....	0.87 1/2
		com. 351,115	50.00	1,843,355	12,209,088	Oct. 15, 1919.....	1.50
United Verde Copper, Arizona.....	copper	300,000	no par value	2,250,000	52,847,000	Dec. 10, 1919.....	1.50
United Verde Extension, Arizona....	copper	1,050,000	0.50	2,362,500	11,130,000	Nov. 1, 1919.....	0.50
Utah Apex, Utah	c.l.s.g.	528,200	5.00	.....	1,122,425	Nov. 11, 1918.....	0.25
Utah Con., Utah	c.l.s.g.	300,000	5.00	75,000	12,810,000	Mch. 25, 1919.....	0.25
Utah Copper, Utah	copper	1,624,490	10.00	9,746,940	101,761,722	Dec. 31, 1919.....	1.50
Utah Metal, Utah	c.l.s.g.	691,588	1.00	.....	895,734	Dec. 10, 1917.....	0.30
Vindicator Con., Colorado.....	gold	1,500,000	1.00	60,000	3,832,500	Oct. 25, 1919.....	0.01
Wellington Mines, Colorado.....	l.z.	1,000,000	1.00	100,000	1,950,000	Jan. 2, 1919.....	0.10
West End, Nevada	s.g.	1,788,486	5.00	178,849	1,251,940	Dec. 9, 1919.....	0.05
Wolverine, Michigan	copper	60,000	25.00	150,000	10,220,000	Oct. 1, 1919.....	0.50
Yellow Pine, Nevada	z.l.	1,000,000	1.00	150,000	2,503,008	Dec. 30, 1919.....	0.06
Yukon Gold, Alaska, Cal., Nev....	gold	3,500,000	5.00	.....	9,858,110	June 1918.....	0.02 1/2

CANADA

Belmont Surf Inlet, British Columbia	g.e.	2,500,000	1.00	250,000	250,000	July 1, 1919.....	0.05
Buffalo, Ontario	silver	500,000	1.00	.....	3,287,000	Aug. 10, 1918.....	0.25
Coniagas, Ontario	silver	800,000	5.00	400,000	9,640,000	Nov. 1, 1919.....	0.12 1/2
Con. M. & S., British Columbia....	l.c.c.s.g.	419,093	25.00	1,052,120	6,046,226	Oct. 1, 1919.....	0.62 1/2
		1,100,000	1.00	17,650	35,300	April 20, 1919.....	0.01 1/2
Florence, British Columbia	l.s.z.	150,004	100.00	562,467	10,339,352	May 1, 1919.....	1.25
Granby Con. M. S. & P., B. C.	c.g.s.	240,000	10.00	48,000	2,460,000	June 30, 1919.....	0.10
Hedley, British Columbia	gold	4,920,000	5.00	1,722,000	11,146,000	Dec. 31, 1919.....	0.05
Hollinger, Ontario	gold	1,984,150	1.00	396,830	694,453	Oct. 15, 1919.....	0.05
Howe Sound, B. C. and Mexico....	copper	com. 1,673,384	25.00	.....	52,276,984	Dec. 1, 1918.....	1.00
	n.c.	ptd. 89,126	100.00	534,756	7,486,470	Nov. 1, 1919.....	1.50
International Nickel, Ontario		600,000	4.00	900,000	8,910,000	Sept. 22, 1919.....	1.00 1/2
Kerr Lake, Ontario	gold	2,000,000	1.00	100,000	200,000	Oct. 25, 1919.....	0.02 1/2
Lake Shore, Ontario	silver	2,247,692	1.00	269,715	5,619,310	Oct. 7, 1919.....	0.03
McKinley-Darragh, Ontario	gold	3,640,283	1.00	364,028	1,445,613	Aug. 15, 1919.....	0.05
McIntyre, Ontario	silver	1,660,050	5.00	622,519	6,528,616*	Sept. 16, 1919.....	0.12 1/2
Mining Corp., Ontario	silver	1,200,000	5.00	1,500,000	20,640,000	Oct. 21, 1919.....	0.25
Nipissing, Ontario	l.z.s.	1,750,000	1.00	17,500	560,000	Feb. 15, 1919.....	0.01
Rambler-Cariboo, British Columbia.	l.z.s.	2,000,000	1.00	.....	2,700,000	Oct. 15, 1917.....	0.05
Standard, British Columbia.....	silver	2,500,000	1.00	.....	2,125,000	Jan. 18, 1918.....	0.03
Temiskaming, Ontario	gold	531,500	5.00	.....	398,625	Jan. 15, 1917.....	0.12 1/2
Tough-Oakes, Ontario	silver	1,000,000	1.00	50,000	1,211,999	Jan. 2, 1919.....	0.05
Trethewey, Ontario							

Company Reports

TOMBOY GOLD MINES CO., LTD.

Report for year ending June 30, 1919.

Property: mine, concentrator, and cyanide plant in Telluride districte, Colorado.

Operating Officials: D. A. Herron, general manager; J. S. Peterson, assistant manager.

Financial Statement: bullion and concentrate production for the year, \$864,699; cost, \$781,397; net profit, \$83,302.

Dividends: none in 1919. Total to date, \$4,074,200.

Development: little work done in Argentine group; ore-reserves estimated to be 200,000 tons. Only 1378 ft. of development work in Montana group due to scarcity of labor. The north drift of the Virginus vein was followed 552 ft. Ore-reserves estimated to be 300,000 tons.

Operations: 155,334 tons ore milled; 122,624 tons of tailing cyanided. Mining cost \$2.21; milling, \$0.67; concentrating, \$0.53; cyaniding, \$0.88; general and other expense, \$0.74.

Production: bullion, \$265,796; concentrate, \$437,713; cyanide bullion and slag, \$161,190.

EL ORO MINING AND RAILWAY COMPANY, LTD.

Report for the year ending June 30, 1919.

Property: mines and railway at El Oro, Mexico.

Operating Officials: A. F. Main, general manager; F. Jenkins, assistant manager.

Financial Statement: the annual report gives 'profit and loss' accounts of years 1916, 1917, and 1918, which show a loss of \$19,000, a profit of \$95,000, and a profit of \$57,000, respectively. The net profit for 1919 was \$391,197. During the year State and Federal taxes amounted to \$299,578. The railway earned \$117,219, net. Balance sheet shows a credit of \$229,621 in war and exchequer bonds.

Dividends: dividend No. 28 of 1s. per share was paid on October 31. Total to date: \$2,000,000.

Development: developed ore on June 30, 1919, was 333,000 tons as compared with 292,000 tons on June 30, 1918. Working costs were \$6.80 per ton.

Production: ore treated totaled 308,717 tons of an assay value of \$8.79. Bullion produced \$526,697. Net recovery of gold and silver was 90.11%.

SANTA GERTRUDIS COMPANY, LTD.

Report for year ending June 30, 1919.

Property: mine in Pachuca district, Mexico. Also 60-stamp mill and cyanide plant.

Operating Officials: Hugh Rose, general manager; C. A. Lantz, assistant manager; T. C. Baker, mine superintendent.

Financial Statement: profit for the year, \$158,408. Brought forward, \$1497. Appropriations and dividends, \$151,584. Carried forward, \$3322.

Dividends: dividends No. 8 and 9 amounting together to \$150,000 were distributed.

Development: the estimated ore-reserves on June 30, 1919, were 718,500 tons containing 44,565 oz. of gold and 7,921,000 oz. of silver. Development during the year amounted to 8162 ft. of drifting and cross-cutting.

Production: 381,428 tons of ore was treated from which 24,359 oz. of gold and 4,304,812 oz. of silver were recovered as bullion. Labor conditions were satisfactory. Operating cost is still high on account of cost of supplies and high wages.

CAMP BIRD, LTD.

Report for year ending June 30, 1919.

Property: mine and stamp-mill near Telluride, Colorado. Large holdings of Santa Gertrudis stock.

Operating Officials: Thos. H. Woods, general superintendent; J. B. Glasser, purchasing agent.

Dividends: No. 17 and 18 amounting to \$45,473 were paid during the year.

Development: 3212 ft. of development work.

Operations: confined entirely to mine development. Mill did not run during the fiscal year.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

FEATURES OF THE ELECTRICAL EQUIPMENT OF THE ALASKA JUNEAU GOLD MINING COMPANY

By F. Seward Rice

The first unit of the 6000-ton concentrator of the Alaska Juneau Gold Mining Co. was put into operation in June 1917. This plant was built to treat the gold-bearing ore from the Alaska Juneau mine, one mile north-east of Juneau, Alaska. The concentrator-site adjoins the city of Juneau



Fig. 1. Concentrator, Just South of Juneau

on the south-east, and is built on a steep rocky cliff fronting Gastineau channel and nearly opposite the famous mine and milling-plant of the Alaska Treadwell Gold Mining Co. on Douglas island.

Electric-power is generated in a 12,000-kw. steam-turbo generator-plant which was built in 1916. This power is used throughout, for all mining and milling operations. The steam station is tied-in through a bank of 22,000-volt transformers with the distribution system of the Alaska Treadwell Gold Mining Co. This distribution system is fed by both hydro-electric and steam plants and through the arrangement in force all plants of both mining companies are able to interchange power and serve as auxiliary sources of electric energy. Only one-half of the ultimate capacity of the Juneau steam-station was installed at first. This consists of a 6000-kw. horizontal steam generator with corresponding boiler-plant and auxiliaries.

The broken ore in the mine is gathered with Baldwin-Westingshouse storage-battery locomotives of approximately 5½-ton weight equipped with Edison A-10 batteries. From the mine the ore is hauled to the mill, a distance of two miles, in trains handled by Baldwin-Westingshouse trolley locomotives. The railway is also used for handling supplies between the mill and the mine. The double track has a maximum grade of ½ of 1% in favor of the load descending from the mine to the mill, and passes through three tunnels. Between tunnels the road is protected by snow-sheds wher-

ever it is exposed to slides, which were formerly a frequent source of trouble. The ore-trains are made up of cars of 10 tons capacity each. The average train weighs 416 tons loaded and 96 tons empty. The locomotives are articulated tandem-units particularly designed for the service. Each locomotive consists of two 9-ton bar-steel units. Each unit has two motors, the control for all is assembled in a cab on the rear end of the loading-unit. These 18-ton locomotives were built to special dimensions in order to conform to the gauge, which is 30-in., and in order to permit the locomotive passing entirely through the tippie at the mill. The motors are the Westingshouse No. 905 type, which are provided with forced ventilation. The compressors are mounted on the leading unit of the tandem, while the air-storage cylinders are divided so that the cylinder for straight air is on the leading unit while the auxiliary storage-cylinder for automatic air is on the trailing unit. Through this arrangement the leading unit may be disconnected from the trailing unit and used by itself as a switching-locomotive with air-brake equipment. The locomotives are somewhat unique in that considerably more apparatus has been mounted upon them



Fig. 2. Synchronous Motor in Crushing Department

than is usually found in units of this size. Still, it has been so well placed, and so compactly grouped that the whole appearance of the locomotive is good and accessibility of all parts is excellent. The locomotives have been found to be easily handled under exacting service conditions and have shown that they are fully capable of hauling in two 8-hour shifts the full tonnage of ore required to keep the mill running at maximum capacity three shifts per day.

The direct-current power-supply for the railroad is derived from two 300-kw. rotary converters, one situated in the power-house, and one in the Gold creek substation. The latter feeds into the trolley near the portal of Sheep creek tunnel, two-thirds of the distance from the mill to the loading-bins in the mine. Each rotary converter has its individual 300-kw. 6-phase transformer. The one in the power-

house has a primary voltage of 2300, corresponding to the generated voltage, and the other has a primary voltage of 22,000, which is the voltage of the Alaska Treadwell company's transmission system.

The ore from the trains coming from the mine is dumped into the crude-ore receiving-bins at the mill by either of two revolving tipples. These tipples have a capacity of 4 cars each. They are each driven by a 25-hp. 550-volt D.C. motor.

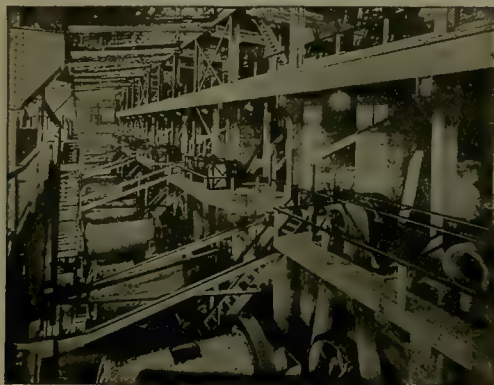


Fig. 3. Ball-Mill Department

It is possible to dump an entire train of 32 cars in a period of 10 minutes. The tipple motors are hand operated by reversing-drum controllers which serve to align the wheels with the track rails whenever the tipple is turned over. It has been found that there is considerable force tending to accelerate the motion of the tipple during the last quarter revolution, due to the fact that the centre of gravity of an empty car is below the axis of the tipple. Consequently in order to bring the tipple rails quickly into alignment with

motors are entirely suitable for such service. The motors have given entirely satisfactory mechanical performance and at the same time provide the additional advantage of improving the power-factor of the electrical distribution-system. The slow speed which can be efficiently obtained with synchronous motors has permitted the elimination of counter-shafting and extra belting, thus permitting a most excellent arrangement of the crushing department from the mill-operator's point of view.

The crushing department is in two sections, each containing two No. 9 gyratories set to crush to 3 in. and a 36 by 48-in. jaw-crusher. Each section is driven from a single shaft to which the crushers are connected by friction-clutch pulleys. Each shaft is directly coupled to a 350-hp., 420-kva., 360-r.p.m., 2200-volt Westinghouse synchronous motor, with direct-connected exciter. The motors are designed with heavy starting-torque and good synchronizing characteristics, so that even in case of the clutches becoming clogged with dust, they will permit starting without undue strain. The starting control for the motors has been simplified to such an extent that the operation of putting them into service is entirely analogous to the starting of an induction motor. The use of direct exciters permits the motor fields to be short-circuited through the exciter-armatures, and the exciter builds up voltage as the synchronous motor comes up to speed.

The grinding department of the concentrator has twelve 8 by 6-ft. ball-mills, each driven from a 225-hp., 435-r.p.m., 2200-volt, type 'CS' motor. Fine grinding is done in twelve 6 by 12-ft. tube-mills, each driven by a 150-hp., 435-r.p.m., 2200-volt, type 'CS' Westinghouse motor. Although it was anticipated that the starting-duty of these motors would be rather severe, squirrel-cage motors were chosen instead of slip-ring motors. Slip-ring motors have been more often used for this class of service in order to obtain adequate starting-torque and to relieve the generating-station of the high peak during starting. In the present instance the peak

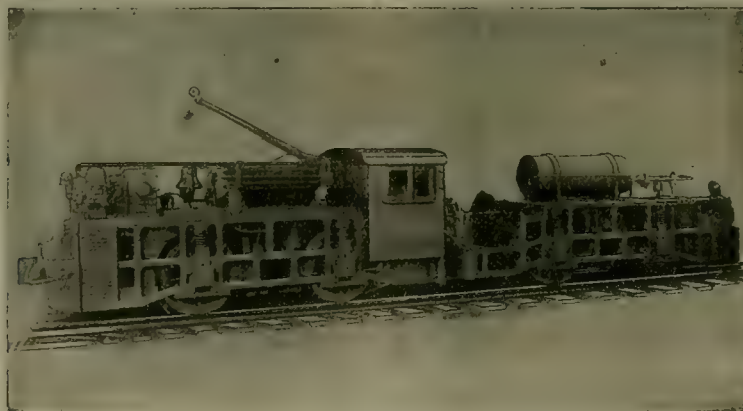


Fig. 4. Special 18-Ton Electric Locomotive

the track rails without over-running the centre, it is frequently necessary to plug the motor, and to have a means, such as is provided in the drum controller, of easily reversing it, in the event that the tipple turns past its track-centre.

The coarse-crushing department at the mill is somewhat unusual in that the crushing-machinery is all driven by synchronous motors. This type of motors has not generally been used for this duty, but there is no reason why a properly designed synchronous motor should not be applied to crusher-drives. The success of the Juneau aporations has definitely proved that properly constructed synchronous

drawn by any of these squirrel-cage motors was small in comparison with the capacity of the power-system and adequate torque was ensured by designing the motors for as high a starting-torque as could be secured without sacrifice of efficiency. The slight resultant sacrifice in power-factor was offset by the synchronous installation in the crushing department. Squirrel-cage motors seemed advisable owing to the simplicity of their starting equipment and the elimination of any possibility of trouble from dust, which was anticipated owing to the dry quality of the ore. In order to simplify starting, both the ball-mill and the tube-mill motors are thrown directly on full-line voltage by means of specially

selected circuit-breakers, no starting compensators whatever being used. Each ball-mill and tube-mill has a friction-clutch pulley on its pinion-shaft so that the motor can be started ahead of its load, but in actual practice these clutches are seldom used and the motors have proved fully capable of starting satisfactorily with the mills connected. As the torque of an induction-motor is very nearly proportional to the square of the voltage impressed on its terminals, the maximum possible starting-torque is secured by connecting the motors directly to the 2200-volt circuit as described above. Of course, this high starting-torque is secured at the expense of drawing a large line-current from the power-feeder at the moment of starting. Ordinarily this large current-flow might produce poor voltage regulation on the feeder, and might impose a heavy momentary drag on the prime mover at the generating station. The first source of difficulty is obviated by the use of amply heavy feeder-cables, and in this particular installation the second creates no trouble owing to the comparatively large capacity of the power-supply. The large available power-supply was taken advantage of in this case to secure the maximum simplicity of electrical operation.

Special forms of belt-drive from the motors to the mills were selected owing to the steep gradient of the ground on which the mill is situated. Short vertical centre-drives with counter-weighted idler-pulleys are used and are so arranged that they occupy a minimum amount of horizontal space. This was a desirable feature owing to the economy in limiting the width of the mill section. The pulley of each ball-mill motor is directly beneath the driven pulley on the pinion-shaft of the mill which it drives. The drive on the tube-mills is similar, except that they are so arranged that the motor-pulley is directly above the driven pulley on the mill-pinon-shaft. It will be seen that in the case of the ball-mill motors the shaft re-action due to the belt-pull is vertically upward against the bearing-caps. A careful check of the design of the bearings prior to installation showed that they were amply capable of taking care of this vertical reaction and no trouble due to this feature has been experienced.

The water-supply for the mill and the circulating cooling-water for the plant condensers is pumped from Gastineau channel. The pumping-plant is in a sub-basement of the power-house. The pumps are set 18 ft. below maximum high-tide level in order to equalize the head due to tide-variation, which at its greatest rise amounts to 26 ft. The mill-pumps, of which there are two, have a combined capacity of 6000 gallons per minute, and are driven by 400-hp. direct-connected squirrel-cage type induction-motors. These pumps deliver water to the storage-tanks above the concentrator. Circulating-water is pumped by two centrifugal pumps, each of 12,000 gallons per minute capacity. Two 300-kva., 720-r.p.m., 2200-volt synchronous motors drive these pumps. These motors are designed to carry from 180 to 270 mechanical horse-power with maximum power-factor correction. They are coupled to the pump-shafts through jaw-clutches, which when disconnected permit the use of either motor as a synchronous condenser for power-factor correction. The rheostats in the field-circuits of these motors are controlled either from the motor-starting panels near the pumps in the basement or from the main switchboard in the power-house on the floor above. Instruments and remote-control field-rheostat at the latter position give the switchboard attendant control of the amount of power-factor correction which it is desired to effect.

The design of these synchronous motors differs considerably from those used in the crushing-plant. For the motors in the crushing-plant, as explained above, high-starting torque was desirable. In starting centrifugal pumps the starting-torque is low, but the required running-torque increases as the speed approaches synchronism. Therefore,

the synchronous pump-motors were designed with particular regard to obtaining high-synchronizing torque. The design employed giving a synchronous-torque of 33% of full-load torque has proved entirely successful. These motors are not provided with direct-connected exciters, but obtain their excitation from the exciter circuit in the power-house.

The complete crushing and concentrating-plant, as well as the power-house of the Alaska Juneau Gold Mining Co., were designed by Bradley, Bruff & Labarthe, engineers, of San Francisco. The electrical equipment described above, including all motors, rotary converters, transformers, and switchboard, was supplied by the Westinghouse Electric & Mfg. Co., who designed the locomotives, the synchronous motors, and the motors for the grinding-department along special lines to meet the requirements specified by the plant designers.

COMMERCIAL PARAGRAPHS

W. E. Hardy, F. H. Rice, and H. H. Whitesel, and associates who have been operating the **Boston Belting Corporation** (so far as production and sales are concerned) have purchased and taken over all assets of the corporation which relate to the mechanical rubber goods business.

The **National Tube Co.** has issued Bulletin No. 24, discussing the 'Rise of Steel Pipe'. Showing the growth in the manufacture of steel pipe from practically nothing in 1888 to more than 2,000,000 tons in 1918 and pointing out the advantages of steel as compared with wrought-iron pipe.

'Insuring Full Return on Truck Investments' is the title of a new 8½ by 11 four-page descriptive leaflet known as Publication 806, printed by **The Cutler-Hammer Mfg. Co.**, of Milwaukee and New York. This leaflet describes and illustrates the new C-H automatic sectional type of battery-charging equipment for charging battery-driven vehicles, trucks, and locomotives.

The **Wisconsin Bridge & Iron Co.**, with general offices and works at North Milwaukee, has opened an office at 709 Caples building, El Paso, Texas, with E. P. Rankin, Jr., in charge. The company is now engaged in constructing the new Bisbee concentrator for handling ore from the Phelps Dodge mines at Sacramento mountain. Mr. Rankin has been designing and contracting in the South-West for the past ten years.

The **Hardinge Company** is the new corporate name of the **Hardinge Conical Mill Company**, whose main office is at 120 Broadway, New York, with branch offices at Denver, Salt Lake City, Spokane, and London. This alteration in name in no way indicates any change of policy as regards the building and distributing conical mills, but is rather in keeping with the idea of efficiency, and also reflects enlargement in the scope of activities.

'Worthington Condensing Apparatus' is the title of a new booklet issued by the **Worthington Pump & Machinery Corporation**. The first 85 pages are devoted to illustrations and reading matter descriptive of the various types of condensers made by the Worthington company, together with auxiliary apparatus. This is followed by 26 pages of useful information for the benefit of steam users and engineers. It is an attractive publication.

A change in the merchandising policy of the **R. D. Nuttall Co.**, of Pittsburgh, Pennsylvania, has been announced, effective January 1, 1920. Under the new arrangement the **Westinghouse Electric & Manufacturing Co.**'s salesmen throughout the United States will handle the railway and mine products of the **R. D. Nuttall Co.** All Nuttall industrial lines and other products, however, will be taken care of through the main Nuttall office at Pittsburgh, Pennsylvania.

Realizing the tremendous possibilities in the Orient for intensive sales development, the **Pioneer Rubber Mills** of San Francisco will send D. D. Tripp, vice-president, on an

extended tour through that territory. Mr. Tripp will leave shortly and will visit Japan, China, French Indo-China, India, Straits Settlement, Java, Manila, Australia, etc. Mr. Tripp is really going in the role of a trained observer, as he will be accompanied by the regular line salesman.

I. F. Baker of the Westinghouse Electric International Co., who has been at the New York office of that company for the past two years, is now on his way to Tokyo, Japan, where he will act as a special representative of the International company. Mr. Baker entered the graduate student course about 1908, later serving in various capacities in the resale and contract sections of the sales department. In 1913 he was transferred to the foreign department which later became the Westinghouse Electric International Co. Mr. Baker has many friends in the Electric as well as in the International company and will carry with him their best wishes for success in his new field.

The Cutler-Hammer Mfg. Co., of Milwaukee, has revised and reprinted two of their standard descriptive booklets. Booklet 'A' describes the C-H motor-operated brakes for alternating current service, made for application similar to the direct current type M magnet brake, such as used for cranes, elevators, mine hoists, and other kinds of conveying and hoisting machinery. Booklet 'S' illustrates and describes the C-H magnetic separator which is used in 35 different industries. The three principal uses may be classified as follows: (1) Cobbing, or removal of stray iron that would injure crushing, grinding, or cutting machinery; (2) recovery of iron for its intrinsic value, as found in refuse sands from foundries; and (3) the purification of products.

The Coast Equipment Co. with offices in the Merchants Exchange building, San Francisco, has been appointed exclusive sales agent for California and Nevada for the following companies: Ridgway Dynamo & Engine Co., manufacturing turbo-generator sets, alternating and direct-current generators, motor-generator sets, steam-engines, and synchronous motors; Pittsburgh Transformer Co., transformers; Atlas Car & Manufacturing Co., electric storage-battery and trolley locomotives, storage-battery flat-cars and industrial cars; Norwalk Iron Works Co., air, oxygen, hydrogen, and carbonic-acid gas compressors, and automatic ammonia compressors; Duncan Electric Manufacturing Co., watt-hour meters. The company has recently opened an office in the San Fernando building at Los Angeles, in charge of Ralph B. Clapp.

Many industrial plants are using Oronite roof paints not only for painting both metal and prepared roofing, but also as a protective coating in all cases where an extra heavy or thick coating is necessary. Other plants are using this paint for repairing old paper roofs that have got into bad condition. In this connection it has given perfect satisfaction when used for patching holes in old roofs. A certain sugar company in California uses Oronite roof paint on pipelines at its plant with excellent results. A copper company in Arizona is using it for protecting fuses in wet holes, and state that it is the best material it has ever found for the purpose, as there has not been a missed shot since its use. Another use of Oronite, and one for which it is excellently suited, is on cuts, abrasions, and wounds of trees. Many municipalities are employing it for this purpose.

The Booth Electric Furnace Co. has opened the following district offices in connection with the sale of electric furnaces for melting steel, iron, and non-ferrous metals: For New York and New England, Edward B. Stott & Co., Flatiron Bldg., New York City, with E. F. Tweedy, secretary of the company, directly in charge; for eastern Pennsylvania, New Jersey, Maryland, Delaware, and southern Atlantic Coast States, Northern Engineering Co., 308 Chestnut St., Philadelphia, with F. W. Doran in charge; for north-eastern Ohio, western Pennsylvania, and western New York State, C.

L. Foster, formerly sales manager of the Electric Furnace Co., of Alliance, Ohio, with offices at 879 The Arcade, Cleveland, Ohio. In connection with these district offices a complete staff of engineers and metallurgists will be maintained so that the needs of customers can be promptly met and adequately taken care of.

The Barrett Company, well-known producers of flotation reagents, has announced the establishment of a flotation-oil department. The increased use of coal-tar products in this important branch of metallurgy has necessitated this step. It is understood that the function of this new department will be to carry on a conservative advertising campaign in favor of a more general use of coal-tar products in flotation, and to bring to the assistance of the mining companies its knowledge of coal-tar technique with the idea of assisting them to choose their flotation reagents more intelligently. The new work has been put in charge of F. G. Moses, a flotation engineer of broad experience. Mr. Moses recently severed his connection with the Salt Lake City station of the U. S. Bureau of Mines to take up this work for The Barrett Company. Before entering the employ of the Government he was engaged as a flotation engineer on the staff of J. M. Callow, during which time he investigated ores and operated flotation plants in various sections of the country. He has a wide understanding of the problems encountered by the flotation operators. Mr. Moses is also known as the author of several timely articles on flotation which have appeared in the technical press.

Fairbanks, Morse & Co. will start the erection in Beloit next year of the most modern foundry in the world. It will equal in size and output any foundry on the globe. This great structure, when completed, will be 900 ft. long, 550 ft. wide, and will contain 495,000 sq. ft. of floor space. This structure, including storage of flasks, iron, sand, etc., which will also be under the roof, will cover eleven acres of ground. It will be located directly to the north of the present powerhouse, bordering the River road. The plant when completed will have an ultimate capacity of 350 to 400 tons of gray iron daily. This big foundry will eventually employ 1500 additional men; and 1500 more men will be required in other departments of the factory to meet the increased production that will result. This means an addition of 3000 workmen for the great plant, an increase of 75% in its industrial army. Fairbanks, Morse & Co. will then employ 7000 men. Plans and specifications for the big foundry are rapidly nearing completion. Raw material for its construction will be placed on the ground this winter and work will be begun as soon as the frost is out of the ground. The officials of the company decline to give out figures as to the cost, but it is hinted that at least \$1,500,000 will be expended. Many months have been spent in planning this enterprise, with the result that every protection for the safety and health of the employees, every modern scientific foundry device, every improvement in the casting of gray iron will be incorporated in the Beloit plant.

Electric cranes will carry the raw materials to and from the big cupolas. Electric grab-buckets will unload the molding and core sand and coke. Electric magnets will grip the raw pig-iron and remove it from the cars. Electric cranes and conveyors will carry all molten metal from the cupolas to every mold, whether for giant castings of 10,000 lb. or for tiny ones of a few ounces. When the eleven-acre building is completed it will be the most up-to-the-minute foundry in the world not only in efficient handling of materials but in provisions for ideal working conditions. In order to ensure a maximum of comfort for the workmen the plant will contain a complete ventilation system that will change the air in the vast structure frequently; individual lockers for all workers; a complete system of hot and cold shower baths for the entire force; and a modern cafeteria where the men can secure hot meals.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 150 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, FEBRUARY 21, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

Page

EDITORIAL

NOTES	255
A MEDAL FOR MR. SULMAN.....	256

The Institution of Mining and Metallurgy in London awards its gold medal to H. L. Sulman on account of his contributions to metallurgy. His recent paper. His intimate association with the Minerals Separation company. His failure to refer to previous writings. The award displeasing to American mining engineers, who have suffered from the tyranny and extortion of Minerals Separation.

THE RAILROADS	257
---------------------	-----

Importance of the railroads as property. Their part in the national economy. Statement by Walter D. Hines, Director General of the Railroad Administration. Excessive costs. Comparison with U. S. Steel Corporation. Increase of wages is less than supposed. Comparative statistics. The eight-hour regulation. Total deficit. Effect of coal strike. Further raise of rates inevitable. Condition of the railroads and rolling stock. Guarantee of investments. A poor experiment.

DISCUSSION

CHLORIDIZING PROCESSES

By Stuart Croasdale	259
The importance of rapid heating. The long cement-kiln type of rotary furnace. Method of employing it.	

HERBERT HOOVER

By J. Nelson Nevius	259
The present situation is abnormal. The qualifications of the next President are not the usual ones. 'Hoover-for-President-on-any-ticket' expresses the need of the times. Now is the psychological moment. Let the engineers act!	

PUBLIC SERVICE AND PRIVATE PRACTICE

By Lester S. Grant	260
Ethics and economics clash. Salaries are low. Outside income supplements them. The student wants a 'practical' instructor.	

ARTICLES

Page	THE BUNKER HILL ENTERPRISE—V	
	By T. A. Rickard.....	261

The prevailing geologic formation. J. R. Finlay's description of the lode. F. L. Ransome and F. C. Calkins diagnose the ore deposit for the U. S. Geological Survey. Their report. The work of Oscar H. Hershey in mapping the Wardner quadrangle. The formations and faults identified by Hershey. His hypothesis of the ore deposition. Mr. Ransome's protest at the implied criticism of Mr. Hershey. The eternal fitness of things. Mineralogy of the Bunker Hill lode.

MINING EXPLORATION

By J. H. Farrell.....	269
-----------------------	-----

New discovery and exploration is not keeping pace with the depletion of ore deposits. The decline of prospecting. Conditions today. What the so-called exploration companies are doing—and what they are not doing. The out-of-dateness of U. S. Geological Survey reports. A remedy suggested. More digging. Lack of personal incentive. A possible lesson from the Lake Superior district.

STATISTICAL REVIEW	273
--------------------------	-----

Production of base metals for 1919 from Alaska; Arizona; and Washington.

DETONATING DYNAMITE	278
---------------------------	-----

Four methods available. All secure practically the same energy from the charge. Comparative advantages. Electrical method preferable except for high first cost.

NOTES

BLASTING ACCIDENTS FROM MISSED HOLES.....	277
---	-----

DEPARTMENTS

REVIEW OF MINING	279
THE MINING SUMMARY	285
STATEMENT BY MR. HOOVER.....	286
PERSONAL	286
THE METAL MARKET	287
EASTERN METAL MARKET	288
COMPANY REPORTS	289
BOOK REVIEWS	290
INDUSTRIAL PROGRESS	291

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.

Massco Mechanical Rubber Goods

Bulletin Number 60

Special Bulletin
announcing

Massco
MECHANICAL
RUBBER
GOODS.

THE MINE AND SMELTER SUPPLY COMPANY
DENVER SALT LAKE CITY EL PASO
New York Office 42 Broadway

THE MINE AND SMELTER SUPPLY CO.
MASSCO
AIR DRILL HOSE
DENVER SALT LAKE EL PASO NEW YORK

We are stocking a new and complete line of Belting, Hose and Packing in all our Branch Houses under the Massco Brand.

Stocks run from standard grades, suitable for ordinary service to the highest possible qualities where the most severe conditions are encountered.

The Massco Brand stands for a standard of value in mechanical rubber goods.

We stand squarely behind every Massco Belt, Massco Hose or piece of Massco Tubing or Packing that goes into your equipment.

Send for Bulletin 60—pictured above

The Mine & Smelter Supply Co.,
DENVER SALT LAKE CITY EL PASO NEW YORK





FROM Houghton comes the following telegram: "At a meeting of student body Michigan College of Mines Mr. Herbert Hoover was unanimously endorsed and urged to run for Presidency of the United States of America regardless of party, at present the College assays 85% ex-service men and of voting age. J. M. Flanagan, Secretary, Student Body." We always thought that the Michigan College of Mines was a first-rate institution, and now we know it.

DETAILS of Mr. Hoover's life are being given by his friends, as would be expected. Some of them are erroneous. For example, Dr. Jordan, at Berkeley, talked a good deal of nonsense about a gold mine in Burma out of which Mr. Hoover had made his fortune. The Bawdwin mine, of the Burma Mines Corporation, is not a gold mine, as most of our readers know; it yields silver, lead, and zinc. Mr. Hoover sold his stock in it three years ago, at a moderate price. It was not the source of any large part of his fortune, which has been the fruit of 25 years of highly successful professional work, supplemented by participation in scores of honorable mining enterprises. On page 286 we publish a statement by Mr. Hoover. It has a touch of humor that lightens these days of gloom and rancor.

COAL operations is to be the subject of an inquiry initiated by Mr. Herbert Hoover, in his capacity as president-elect of the American Institute of Mining Engineers, which organization will hold its annual meeting at New York on February 17. The engineers will have a conference, to discuss the stabilization of the coal industry, that is, to ascertain how much the intermittent operation of the mines and the consequent irregular employment of the miners are necessary. The Director of the U. S. Bureau of Mines, Mr. Van. H. Manning, and the Director of the U. S. Geological Survey, Mr. George Otis Smith, will lead the discussion. They will be followed by Messrs. H. H. Stoeck, S. L. Yerkes, and Eugene McAuliffe. A timely and useful exchange of ideas is assured. At this meeting Mr. Hoover will preside, as President. This is a good omen, is it not?

CANADIAN GEOLOGISTS are like American geologists in expecting their government to give them a living wage. We referred recently to the loss suffered by the personnel of the U. S. Geological Survey on account

of resignations caused by the inadequacy of the salary paid to members of the staff. The same blight has fallen upon the Canadian Geological Survey. Out of a field staff of 25, no less than 13 have resigned since last October. As an example of the lack of appreciation for scientific service shown by the Government, and back of it, of course, the Parliament of the Dominion, we may instance a graduate of McGill university who was receiving \$2100 per annum after having been on the Survey for ten years. He was offered, and accepted, \$5600 per annum from Pearson & Son. All the younger men are leaving the Survey, and we do not blame them. One may love the rocks, but one cannot live on them.

SINCE the third article on the Bunker Hill enterprise appeared, in our issue of January 24, we have received a letter from Mr. Walter C. Brower, of Spokane, stating that he was a friend of Noah Kellogg, and that Kellogg, three years before his death, told him the true tale of the grubstake. Mr. Brower has sent us a detailed account, not for publication, of the story as told to him by Kellogg. From this it appears that our surmise as to the main facts was correct. Kellogg's confession may be summarized as follows: He had failed to find any outcrop of gold ore, he had found only the combs of hungry-looking ironstone so common in the quartzite hills overlooking the south fork of the Coeur d'Alene river, and he was about to return disappointed to Murray from his last camp at the mouth of Milo creek. His donkey had strayed up the gulch and to the adjacent hillside. "When Kellogg got near to him," says Mr. Brower, "he saw where he had stepped into a gopher-hole and kicked out a quantity of loose dirt, among which were pieces of shiny white metal. Kellogg picked up as much as a pound of what proved to be galena, and when he looked about him he found the burro standing near a great outcrop of discolored capstone which he could plainly see extending across the creek, and showing on the opposite hillside. The great Bunker Hill dike was discovered." Some of this is Kellogg and some of it, inevitably, is Brower. It is possible that a few specks of unoxidized galena might be kicked out of a hole made by a gopher, but it is unlikely; it is more probable that the vagrant burro found a patch of bunch-grass close to the outcrop and that Kellogg, in looking for his companion, saw the comb of rock and chipped it at a place where unoxidized galena was not

far below the outer cover of oxidized ore. In any event, Kellogg found some galena and located the lode forthwith. So he told Mr. Brower. Then he returned to Murray, where he went straight to O'Rourke's cabin and showed him the "shiny mineral", which O'Rourke recognized as galena, probably silver-bearing. There and then they "put up a job" on Cooper and Peck, who had grubstaked Kellogg. It was agreed that only the pieces of ironstone should be shown to the grubstakers, who had no use for such poor-looking stuff, thereby giving Kellogg a chance to terminate his agreement with them. O'Rourke arranged to go with Kellogg to the scene of the discovery, where Kellogg's first location notice was torn down and thrown aside—to be found later by Peck—while a new notice with their joint names was posted. Mr. Brower says that Kellogg also stated that 'Dutch Jake' eavesdropped into the secret, by listening outside O'Rourke's cabin, and that was how 'Dutch Jake' and Sullivan happened on the scene at the critical moment. We give this version for what it is worth; it is interesting as being a confession, through a friend, of Kellogg's wrongdoing; it is in accord with the facts as disclosed at the trial, and it harmonizes with the inferences that were made in our article on the discovery of the Bunker Hill lode; but it is a sordid tale.

A BILL for the compulsory adoption of the metric system of weights and measures has been introduced in the Senate. As has happened before, the proposal is eliciting vigorous protest. For example, we are informed by one of the opponents of the bill, whose views doubtless reflect those held by other executives in an important branch of manufacturing, that "if the bill is enacted, industry in this country will suffer losses of billions of dollars, and will be thrown into a state of chaos that would result in practical paralysis". Such talk is wild. It is a question largely of shop practice. The change, if made, would doubtless be attended by some confusion, considerable duplication of work, and numerous readjustments, all of which involve an increase in the cost of some manufactures. Changes in gauges, screws, and threads, as also in tools, equipment, and design, would ultimately be needed, but it is hardly true that much of the existing machinery would have to be scrapped. If, by legislative fiat, the inch and the pound and their fellow units were stricken from existence, a serious situation would be conceivable; but the proposed act does not contemplate any such drastic procedure. The metric system was introduced in France in 1793 and more than 40 years elapsed before it was finally established, while in Germany a comparatively short period, from 1868 to 1872, sufficed for the necessary readjustment. A commission in Great Britain is at present formulating a report that is expected to make recommendations favoring a change. Reasonable opponents of the adoption of the metric plan concede that if it had been introduced 50 years ago, it would be superior to the present use of our archaic units. The obvious advantages are so many that no intelligent person attempts to base his argument against the decimal system

on the comparative merits of the two plans. Simplicity, standardization, and economy; these are the arguments in favor of the metric system. The partisan whom we quoted asserts that "if the metric system possessed any merit, it would have been put into use in this country years ago, not by force of law, but by expedience. The very fact that the people of the United States have declined to avail themselves of its principles and abandon the system to which they are accustomed, should justify the denial of the passage of the law to enforce its adoption." A fairer statement would be that the metric system, although based on common sense and scientific principle, is an innovation so disturbing to existing custom that it must not be adopted hurriedly, but that it will be accepted eventually. The transitional period will entail some expense in effort and money; but it is probable that even before the new system is entirely established, the saving accruing each year will more than compensate for such additional outlay, and the resulting benefits will increase constantly. There are features in the present economic situation that render it inadvisable to make the change at this particular time; it were better for the opponents of the metric system to point out such facts than try to hoodwink the public with technical falsities and fluent nonsense.

A Medal for Mr. Sulman

We have been notified officially that Mr. H. L. Sulman has been awarded the gold medal of the Institution of Mining and Metallurgy, London, "in recognition of his contributions to metallurgical science with special reference to his work in the development of flotation and its application to the recovery of minerals". The Secretary adds: "The gold medal awarded to Mr. Sulman is the highest distinction in the power of the Institution to confer." There is a note of challenge in this last statement, and we accept it as such. In the first place we congratulate Mr. Sulman, whom we know quite well, on receiving an award that is indeed a great honor, for the gold medal of the Institution is not carelessly bestowed. Next we say deliberately that the news of this award will be received with regret by members of the mining profession in the United States. We speak for them in saying that while it is true that Mr. Sulman has made a highly meritorious contribution to metallurgical science, he has been closely associated with a company whose policy has been to retard metallurgical progress and stifle technical discussion of the flotation process. A few days ago we received a letter from one of the most distinguished of British engineers, in which he protested against the injustice of our criticism of Mr. Sulman's important paper on flotation, recently published by the Institution. We had objected, as our readers are aware, to the complete absence of reference to the numerous writings on the subject printed in the many years during which Mr. Sulman, for commercial reasons, was silent. Mr. Sulman's paper was written, in large part, from five to ten years ago; it contains much material that others

have published in the interval; notably the American Institute of Mining Engineers, as well as the technical press of the United States; he withheld information of great value to the profession until most of it had ceased to have a timely usefulness; his persistent silence during a decade or more can be imputed only to sinister reasons, for it is not to be supposed that the truth about the principles of the process would jeopardize any advantages to which his associates were justly entitled. His company induced many engineers to sign contracts on the promise of full assistance in the working of the flotation process, yet he and the other metallurgists of the Minerals Separation company withheld such knowledge as they possessed and even attempted to prevent others from publishing the information helpful to the successful application of the process. If flotation was developed successfully on a large scale in the United States, the profession in this country owes no thanks, but the contrary, to Mr. Sulman, who in our deliberate opinion, for reasons given more than once, was not the inventor, or co-inventor, of the froth-agitation process. We objected to the praise offered publicly, at the close of Mr. Sulman's paper, to Mr. John Ballot, the chairman of the Minerals Separation company and the man chiefly responsible for a policy that had aroused the keenest resentment in the United States, and elsewhere. The friend in London who objected to our editorial thought we were unjust because Mr. Sulman is not a director of Minerals Separation, but only consulting metallurgist, with his partner Mr. Picard. Now, to be unjust is as deplorable as to be just is admirable. We try to be just. We assumed—and we were warranted in assuming—that Mr. Sulman approved and abetted Mr. Ballot's policy. Mr. Ballot is not a member of the profession. The fact that Mr. Sulman should go out of his way to express admiration for Mr. Ballot's performance was proof of his approbation. Although Mr. Sulman is not a director of Minerals Separation, preferring, most properly, to be retained in his capacity as technician, there is ample reason for believing that he is a large shareholder and a considerable factor in shaping the policy of Minerals Separation. If Mr. Sulman has ever dissociated himself from the policy pursued by Minerals Separation, we are not aware of it. Next, we venture to recall the fact that the gentlemen in London have not been subjected to the exactions and impositions of Minerals Separation as we have in the United States. At Broken Hill, the only mining district under the British flag where flotation is used on a scale at all comparable with its application in this country, the Minerals Separation process has had to compete with the De Bavay, Bradford, and other methods, so that the Broken Hill companies have not been victimized as otherwise they might have been. The scope of flotation in the United States is so vastly bigger than in Australia, or in any other country, as to make the actions of Minerals Separation a real issue, and a most compelling one. Most of the members of the Institution in London can afford to look at the matter in a complacent way. In contrast, we refer the Secretary of the

Institution to the resolution on the subject passed by the American Mining Congress at St. Louis last September. He will find it in our issue of December 13. It makes all the difference whose ox is gored. As Kipling has said:

"The toad beneath the harrow knows
Each quivering tooth-point where it goes;
The butterfly beside the road
Preaches contentment to that toad."

The Railroads

Railroad property constitutes the largest single item of wealth in the United States and the efficient operation of the railroads is a basic factor in promoting the prosperity of our national industry. The price of every commodity is influenced by the cost of transportation, and the welfare of every branch of industry is more or less dependent upon a cheap and at the same time punctual system of distribution. Therefore the management of the railroads is a matter of concern to every citizen, and it is to his interest that the adjustment scheduled for March 1 should be carried out with the utmost fairness and sagacity. We have read carefully the statement issued to "the editors of the newspapers of the United States" by Mr. Walker D. Hines, the Director General of Railroads. During recent unpleasant years we have thought of Mr. Hines chiefly as the person to whom we were bidden to address our complaints of poor service or bad accommodation on the railroads over which we have traveled, and at this moment we marvel at our self-restraint in having declined to avail ourselves of the opportunity to write to him plaintively. However, this has not been allowed to provoke undue prejudice, so we have read his statement carefully, even sympathetically. He discusses first the alleged excessive costs of railroad operation by his administration. These, he asserts, are not so excessive as they seem, for the operating costs of the U. S. Steel Corporation, for example, were 151% more in 1918 than in 1914, whereas those of the Railroad Administration in 1919 were only 102% more than in 1914. Next he states that the Steel Corporation increased its finished tonnage 55% in the four years cited, so that its increased cost per ton was 61%, whereas the railroads increased their service by 26%, so that the increased cost per unit of service was 60% during the five years. As to increase of wages, Mr. Hines quotes the head of the Steel Corporation as saying that the direct labor cost per ton of its products in March 1919 was \$34.61, as compared with \$15.13 in 1913, an increase of 119%. The average pay per hour to labor in the steel industry increased 121% in the six years quoted. On the other hand, the average increase in the pay per hour for all railroad employees increased only 106% during the same period. The increase in wages to railroad employees was, says Mr. Hines, long overdue; the Government could not escape the policy of reasonably uniform treatment; yet the average increase per hour to railroad employees as a whole has been no more than was responsive to the conditions that have forced similar increases

in all industrial enterprises. The increase in the number of employees is due chiefly to the adoption of the 8-hour shift. Between 1917 and 1919 there was an increase of 9.7% in the number of employees and a decrease of 5.9% in the number of hours of work. In 1917 the employees averaged 261.4 hours per month; in 1919, they averaged 218.5 hours per month, that is, 7.1 hours per day as against 8.7 two years previously. It is to be noted that this increase in the number of employees on account of the 8-hour shift does not involve a direct increase in the payroll, because generally the pay is based not upon the number of employees but upon the number of hours worked. Prior to Federal control the train and engine men were working under the Adamson Act, enforcing an 8-hour shift for them, but the other railroad employees were still working longer hours. Another unfavorable factor has been the loss of experienced employees during the War, and since, together with a spirit of unrest that has made men less attentive to their work. These factors have militated against an economical railroad administration. The total deficit on Class I railroads during 22 months of Federal control has been \$480,200,000. Mr. Hines asserts that if the rate increases had been effective at the very beginning of 1918, there would have been no such deficit; he says that it was not practicable for the Railroad Administration to start a general increase in passenger rates until June 10, 1918, and in freight rates until June 25, 1918. He asserts emphatically that "if these increases could have been made effective at the very beginning of Federal control there would have been no deficit whatever from railroad operations up to and including the end of October 1919". After that came the coal strike, which, of course, interrupted railroad traffic to such an extent as to render further comparisons impracticable. The large deficits in November and December, he debits, not unreasonably, to the coal strike. By way of explaining the failure, or the abstention, on the part of the Railroad Administration to increase rates during 1919, Mr. Hines says that, although a small increase in rates was needed to make the railroads self-sustaining, it was thought inopportune to make any change in face of the abnormal conditions arising from the slump in freight business after the Armistice and the subsequent incidence of the coal strike. He adds: "Of course, with a return to private control, consideration immediately thereafter of rates to sustain the credit of the railroad companies is inevitable." Evidently he is in such a hurry to pass the buck that he tangles his phraseology. This is the one weak spot in his apologia. He salves his conscience, or his sense of humor, by saying: "This deficit, therefore, is really due to this conservatism of the administration in deferring a rate increase until it could be reasonably sure as to the basis upon which it ought to be computed." He says that the condition of railroad property is fairly good, although the old equipment has suffered two years of additional wear without being offset by the purchase of as much new equipment as would have been purchased but for the obstacles created by the War. Let us leave Mr. Hines

here; he has done his best to make a good case, and he has told us several things that we ought to remember. It must be admitted that this experiment in Government control was made under untoward conditions. In the first place, the Government had refused to allow the railroad companies to make the rate increases that, later, when it took the job in hand, were found so necessary. Next, of course, the War spoiled the fairness of the experiment, by imposing a set of abnormal conditions. Again, we believe that the common objection to Government control, with the unpleasant changes and restrictions enforced during the War, prejudiced the public against the Railroad Administration; indeed, we think that in our own journeyings we detected a spirit of sabotage on the part of sundry railroad officials who wanted to render the Government control unpopular, as compared with corporate ownership, by giving bad service. Certainly we were subjected to annoyances and breaches of good faith, in the matter of dining-car amenities, sleeping accommodations, and so forth, that would have injured the reputation of any competitive railroad. That is why we are inclined to welcome the return of the roads to the corporations. Shippers will face a rate increase cheerfully if it ensures efficient operation of the railroads. Punctuality is the essence of transportation; promptitude is the very life of commerce. There is a quarter of a million miles of railroad in the United States: the investment may have to be doubled within the next half-century; the 20 billions of capital invested in railroads may have to be increased to 40 or 50 billions. How is confidence to be restored in railroad securities? Apparently it can be done only by making the Government in some way responsible for an adequate return on railroad investments. Congress appears willing to allow the Government to guarantee a return of $5\frac{1}{2}\%$ on the value of the railroad properties as determined by the Interstate Commerce Commission. The outstanding capitalization and bonded indebtedness of all the roads amount to 19 billion dollars, and $5\frac{1}{2}\%$ on this sum would entail annual payments of \$1,045,000,000. Half of any surplus will go for betterment of the weaker lines. The guaranteed return to the roads under Government control has been \$900,000,000 per annum. The railway field has ceased to be one for speculative ventures; the people of this country will no longer tolerate the making of big fortunes out of public utilities; they will be glad to see railroad securities placed in the hands of the proposed Interstate Trade Commission, thereby preventing the recurrence of such misdeeds as are associated with the names of the Chicago & Alton and Rock Island railroads. The legislation now pending in the form of the Cummins and Esch bills should create the machinery for the changes necessary to facilitate the resumption of operation by the railroad companies. Government control has been a failure. It is a pity the experiment had to be tried under such unsatisfactory conditions, but most of us will be glad when the experiment comes to an end and some measure of competition is brought into play as a means of stimulating a better service.

DISCUSSION



Chloridizing Processes

The Editor:

Sir—In his article on this subject, published in your issue of January 17, Mr. Layng states that "the importance of rapid heating is apparently not recognized by Mr. Croasdale, who, after having failed with 25-ft. furnaces, now proposes furnaces of the regular cement-kiln type from 75 to 100 ft. long".

I desire to call Mr. Layng's attention to my paper on the 'Volatilization of Metals as Chlorides' where my original experiments on time variation showed that the maximum commercial volatilization was reached in 30 to 40 minutes after the cold ore was charged into the furnace; also to a subsequent discussion² of this subject where I state: "In this operation there must be at least sufficient temperature to produce chemical action and to make the operation commercial it must be done quickly." This point is again emphasized in a later discussion³ and indirectly, in my reply to Mr. Howe,⁴ when discussing the advantages of a rotary furnace in securing a rapid oxidation and consequently a rapid volatilization of the metals by the continuous rolling or rabbling of the ore.

Where the time of roasting was prolonged to several hours in my original experiments, it was due to the use of a mechanically rabbled reverberatory furnace of the Brown type, which was very popular at that time for roasting ore. We soon found that the ore was exposed to the air too slowly for successful volatilization in this type of furnace, so we turned to the cylindrical type which I think has been found to be the most satisfactory by subsequent investigators.

Our 25-ft. furnace was not a failure so far as the actual volatilization was concerned, but when it was charged to capacity with cold ore it was not long enough to give the ore more than five or ten minutes roast at the volatilization temperature. When fed with a small stream of ore, so that the ore was heated to the proper temperature soon after entering the furnace and had nearly the full length of the furnace, or, in other words, 20 to 30 minutes exposure to the volatilization temperature, the results were all that could be desired.

It is evident that another important feature of this interesting process has been re-discovered and amplified.

Denver, January 22.

STUART CROASDALE.

Herbert Hoover

The Editor:

Sir—To your three consecutive editorials favoring Hoover for the presidency—and to all other editorials and all other expressed opinions of similar purport—Amen.

The grave conditions confronting our nation require that the next President shall be a man of the highest executive ability, broad experience, and broad vision, a genius for organization, and that he shall have the confidence of the masses of the people. Those conditions need not be reviewed here. The more carefully we may have followed developments in our own country and throughout the world, the more seriously thoughtful we are for the future.

In both political parties are men mentioned for the presidency who in normal times might make acceptable presidents. But the times are not normal; conditions are fraught with real danger for the future; and to the thoughtful not one of the exponents of party politics measures up to the high standard required. Mr. Hoover does. The press quotes him as saying in New York on February 9 that he is not a candidate, and as refusing to pledge his vote to either party "blindfolded". Good! This clears the atmosphere and makes him still more desirable to those of us who agree with you, Sir, that the "country is sick of petty politics", and who want the national 'pie-counter' turned into an efficiency department.

What are we going to do about it? Engineers have been criticized for not taking a more active interest in political affairs—and the criticism is justified. We have been negligent of our duties. Now it looks very much as though the right opportunity to do something thoroughly worth-while is at hand. 'Let's go!'

Two months ago the suggestion of Hoover for President looked like an ideal—something to work toward, but not obtainable. Now it is different; for during the past six weeks the spontaneous spread of the Hoover-for-President-on-any-ticket sentiment, among all sorts of people, of all political faiths, and in all parts of the nation, has been amazing. This sentiment is bi-partisan, rather than non-partisan, and what it needs now is a definite nucleus around which it may crystallize. Here is the chance for the engineers; for it is appropriate that engineers should form this necessary nucleus. The Joint Council of Engineers of San Francisco did well in its resolutions of January 13 endorsing Mr. Hoover. (If the Engineers Club was represented, the writer is pleased to have been

¹'E. & M. J.', August 29, 1903.

²'E. & M. J.', September 19, 1903.

³'M. & S. P.', August 9, 1919.

⁴'Mining Magazine', March 1914.

included.) I suggest that the Joint Council go further: that it promptly call a meeting, draw up a brief pledge and by-laws and proceed to take signatures. To start the discussion of details, I would suggest that the by-laws show very plainly that there is not the slightest intention to confine the movement to engineers; avoid the names of political parties and also avoid a distinct non-partisan pledge; make it a Hoover-for-President-on-any-ticket movement. Let the pledge and by-laws be printed on slips suitable for pasting on sheets for signatures, with addresses. Submit them to the engineering bodies throughout the United States, and to everybody else who will circulate them. Let each interested engineer appoint himself a committee of one to get busy; call a local meeting among his friends and neighbors, and stir up others to do likewise. No remuneration for circulating pledges should be accepted for the present.

The idea behind this form of movement is this: it is obvious that the public is in a highly receptive mood, and if started *now*, this movement will attain huge proportions. The time to start a political movement is largely a matter of psychology, for feeling and sentiment influence far more voters than does the most logical reasoning.

With several million voters declared for Hoover-on-any-ticket (and just watch the women join us!), we will serve notice impartially on both political parties that we want Hoover nominated; that we have not the slightest objection to his nomination by both parties, but that if he is not nominated by either party, we shall organize our membership into state, county, and precinct divisions, and proceed to elect Mr. Hoover independently. But we hope that the latter move will not be necessary. Sounds like an 'air castle'? Yes, it does. But let anyone who doubts, take about two days and mention the matter to everyone he meets.

If this movement is delayed there will soon spring up both Democratic and Republican Hoover clubs, which will lead to the same old party schisms and ill-feeling, and consequent lost motion. On the other hand, if a distinct non-partisan independent movement is started (as seemed to be suggested in the resolutions of the Joint Council of Engineers), it will not be open to the serious objection which exists to any third party (and which Mr. Hoover is quoted as disapproving), and it would not have injected into it a lot of jarring issues foreign to the main issue.

J. NELSON NEVINS.

Pasadena, February 12.

Public Service and Private Practice

The Editor:

Sir—Your editorial on this subject in your issue of January 17 omits direct mention of "the root of all evil", which, I believe, is at the bottom of the matter under discussion.

Unfortunately, as is too often the case, the ethics and economics of the question clash. There is at present a decided demand in technical schools for instructors with

a wide practical experience, but the salaries offered are generally far below those commanded by men of ability in the lines that they are expected to teach. I believe in the great majority of cases it is the impossibility of offering adequate compensation that leads the governing bodies of the schools to allow faculty members to engage in private practice. The question resolves itself into whether it is better to have as instructors men who are content with the salaries offered, or men with wider experience who are allowed by their private enterprise to augment their incomes to an amount approximating that obtained in strictly commercial pursuits.

The regrettable examples that you cite of professors as 'experts' are too familiar. Is not this condition in most cases due to the inability of the public to disassociate a man's private acts from his public office, and the playing up of his title by a lawyer, rather than any desire on the part of the individual for such notoriety?

Your statement that "teaching gradually unfits a man for commercial work" is the common belief. We have also to consider the attitude of the student, that any subject is more readily and firmly fixed in his mind when instruction is given by a professor who is personally familiar with and who is keeping up on the commercial application of the course of study. Setting aside the question of income, how may a professor keep himself fit for commercial work and satisfy the student body unless by accepting such private practice as does not interfere with his school duties? And what, other than the commercial one, is the object of attendance of the average student of our technical schools?

LESTER S. GRANT.

Golden, Colorado, January 21.

NICKEL MINERALS are known to occur at several localities in Alaska, but none of the deposits have yet been worked. One group of these deposits is described in a recent publication of the U. S. Geological Survey, Bulletin 712-C. They lie 12 miles east of Spirit mountain, in a high range east of Copper river and south of Chitina river, on Canyon creek. Chitina, the nearest town, is about 21 miles away. The country rock is schist cut by intrusive basic igneous rocks. The chief nickel deposit appears to be connected in origin with the basic igneous rock. The orebody is cut by a fault and has not been developed by underground or surface workings, so that its extent is not known. The ore minerals are sulphides which have been altered by weathering. An analysis of the nickel-bearing sulphide was made, but owing to the presence of impurities a formula for the mineral could not be obtained. The other sulphides are pyrrhotite and chalcopyrite. A selected specimen of this sulphide ore analyzed in the Survey laboratory, contained 7.23% nickel.

SOME TUNGSTEN is obtained by placer mining, especially in foreign countries. Most of the domestic production is obtained from lode deposits. In new districts the ore may often be picked up on the surface of the ground or gouged out from shallow open workings.

The Bunker Hill Enterprise—V

The Geology and Mineralogy of the Lode

By T. A. RICKARD

The Bunker Hill lode traverses rocks that have been much disturbed and faulted; it has itself been dislocated by later faults. The prevailing formation is quartzite, forming part of the Belt group of the Algonkian system, which is of pre-Cambrian age. No younger sedimentary rocks survive in this locality and no direct connection between the mineralization and igneous rocks has been observed, although the regional metamorphism is supposed to be related to underlying granitic intrusives. Several dikes cross the Bunker Hill workings, but they appear to have no influence on the ore deposition, which is closely connected with the structural conditions created by intense faulting. It will be interesting to trace the growth of knowledge concerning the mining geology by quoting successive writers on the subject.

J. R. Finlay, writing on 'The Mining Industry of the Coeur d'Alenes, Idaho',¹ in 1902, says: "All the ores of the region come from typical fissure-veins, in which argentiferous galena is associated with large quantities of siderite. The fissures occupy fault-planes, on which the amount of movement is indeterminate, but probably, in some cases, considerable. The fissure is usually well marked by a streak of gouge, between walls which are slickensided and often beautifully polished. As a general rule, only one principal plane of fissuring can be found in each vein. This is very apt to occur near the middle of the vein, but often forms one wall of the lode. Two defined walls, marked by planes of movement, are extremely uncommon."

Speaking more specifically of the Bunker Hill lode, he says: "This remarkable fissure differs notably from the other veins of the Coeur d'Alenes. It seems to be the sole source of the ore in the Wardner district. For 6000 ft. from the eastern end of the workings of the Bunker Hill & Sullivan to the Viola claim of the Empire State & Idaho, the workings are continuous. From the Viola north-westward to the Crown Point the continuity of the fissure is not so clearly established, but all the ore that has been found follows the same extended line, and the workings on the Silver King and Crown Point display a fissure with the same dip, strike, and general characteristics as in the Bunker Hill."

He describes the country-rock as fine-grained quartzite dipping S 60° to 70°, striking N 70° W, and marked by folds that probably are subsidiary to "the grand fold of the neighborhood". He proceeds: "The fissure strikes N 30° W and dips 40° SW, thus cutting the stratification at a considerable angle, both on the dip and strike—a

fact which is considered to have a great influence on the deposition and arrangement of the ores. It is a remarkable fact that all the mineralization has taken place on the hanging-wall side of the fissure, which therefore forms the foot-wall of the lode. A characteristic white 'gouge' of thoroughly crushed and altered rock lies upon the unchanged country quartzite of the foot-wall. Lying upon this white gouge is a strongly mineralized zone, which begins with a streak of bluish or black gouge containing galena, always very fine-grained. The lamination of the rocks parallel to the fissure-plane is strongly marked for only a moderate distance (from 5 to 50 ft.) from it; but within this zone of parallel lamination the minerals, valuable or otherwise, are invariably fine-grained. The lamination in this foot-wall zone has reduced the rock to the condition of gouge material only for a foot or two next the foot-wall.

"Passing outward from the fissure, we find the mineralization extending far into the hanging wall, which has undergone much fracturing. For from 100 to 300 ft. from the fissure, the joints and seams in the quartzite are apt to be filled with galena, with subsidiary quartz and iron carbonate. Further from the foot-wall, the quartz, siderite, and pyrite predominate, to the final exclusion of the galena. These minerals give the rocks toward the hanging wall a silicified appearance; and in the outer zone of mineralization they make the rock much harder than the country-rock of the hanging wall or the vein itself, nearer the foot-wall, and sometimes the lode forms great bluffs. For this reason, the prominent outcrops represent this portion of it.

"The quartz, siderite, and pyrite in their turn diminish in amount until at, usually, not more than 400 ft. from the foot-wall, all mineralization has disappeared, and the country quartzite of the hanging wall resumes the appearance of the foot-wall quartzite.

"The workable orebodies in the Bunker Hill lode are simply those portions which contain enough galena to pay for working. Ordinarily, such bodies lie partly in the laminated zone next to the foot-wall or fissure, and partly in the fractured rock in immediate contact with this zone, on the hanging wall. In almost every case, orebodies appearing in some places to be at a considerable distance from the foot-wall have been found, when followed up, to connect with it. There are, however, three conspicuous orebodies, the 'workable' connection of which with the foot-wall has never been established. Two of these (the Curtis-Hatton body in the Bunker Hill, and the hanging-wall stopes in the Last Chance claim) seem

¹Trans. A. I. M. E., Vol. XXXIII, 1903.

to follow channels made in some way by the fracturing of the hanging wall in a course essentially parallel to the foot-wall, but at some distance from it; and the third, the Sierra Nevada deposit, is a unique occurrence, which merits a more extended description.

"As a general fact, however, it may be declared that the main foot-wall fissure was the source of all the mineral deposition along the lode; that the ore-bearing solutions have enriched portions of the hanging-wall country wherever a favorable channel existed; and that these channels may have been cross-fractures or local branch fissures, regions of extensive crevice-openings due to jointing, or openings along the bedding-planes of the rocks."

I append the sketch of the Bunker Hill lode that accompanies this description by Mr. Finlay. It is a clear description and provides a reasonable explanation of the lode-structure, in the light of the information then available; but it will not stand the test imposed by the later development of the mine and the more detailed study of the local geology.

Next we come to the more elaborate study made by F. L. Ransome and F. C. Calkins for the U. S. Geological Survey in 1903 and 1904 as embodied in the report² published in 1908. These geologists estimated the thickness of the Algonkian rocks in the Coeur d'Alene at 17,200 ft., of which the Burke formation is 2000 ft., the Revett quartzite 1200 ft., and the St. Regis formation 1000 ft. I mention these three sub-divisions because they are more particularly the ones traversed by the Bunker Hill lode. The Burke formation consists of a variety of rocks ranging from nearly pure quartzite to silicious shale. The frequent ripple-marks indicate that sedimentation took place in shallow water. The Revett formation is more homogeneous and consists almost entirely of a hard, clean, thickly bedded quartzite. The St. Regis is composed of shales and sandstones, and some beds of quartzite, all these members showing marked resistance to erosion and therefore making conspicuous outcrops.

The geologic relations of the Bunker Hill lode are described in the report as follows: "All the ore of the Bunker Hill & Sullivan, Last Chance, and Sierra Nevada mines lies in fine-grained sericitic quartzites thought to belong to the Revett formation. The orebodies are definitely related to a persistent fissure which strikes N 45° W and dips to the south-west at an average angle of 38°. Both strike and dip, however, show considerable local variation. This fracture, locally known as the 'foot-wall fissure', in this report is called the Bunker Hill fissure. It has been traced almost continuously from the Sullivan claim, on the east side of Milo creek, to a point about 200 ft. down the west slope of the ridge between Wardner and Deadwood gulch. . . The fissure has all the characteristics of a considerable fault; but the walls are lithologically identical and whatever faulting has taken place has not perceptibly affected the structural relations of the rocks at the surface. . . So far as ore deposition is con-

cerned, the Revett quartzite found in the Bunker Hill & Sullivan and Last Chance mines may be regarded as homogeneous material. The formation of the orebodies appears to have been conditioned by fissuring and the deposition of the ores exhibits no observable relation to bedding-planes, nor is there anything to suggest that, within the general zone of mineralization, particular beds have been more favorable than others to the accumulation of ore. Details of folding may thus be eliminated from economic consideration. The only eruptive rock known in the Bunker Hill & Sullivan and Last Chance mines is a much altered greenstone dike which is exposed at the half-way switch in the Kellogg tunnel. The dike is about 50 ft. wide and may have been a diabase or a diorite . . . The dike is far in the foot-wall country and apparently has no connection with the orebodies, which are found only in the quartzite of the hanging wall.

"The Bunker Hill fissure is well defined throughout the productive parts [of these mines] and is usually recognized with ease . . . There is almost invariably a thin seam (1 or 2 inches) of tough, nearly black clay gouge which usually shows two or more planes of movement and slickensiding. According to Mr. Easton, this gouge contains lead and manganese. Under this seam is a white, creamy, or buff band, ranging from a few inches to a foot or more in thickness, of crushed quartzite which in places is so finely powdered as to form what is usually termed sugar quartz. The white band contrasts strikingly with the black clay seam. . . The sugar quartz usually passes gradually into the less-disturbed foot-wall quartzite. On the hanging-wall side the black seam is in some places in contact with ore, in others with shattered but barren quartzite.

"Although the quartzite of the foot-wall has been well explored, all the ore so far found . . . has lain in the hanging wall of the Bunker Hill fissure. That no ore should have been deposited beneath the persistent seam of dark gouge characteristic of this fissure is remarkable, as the quartzites³ of the foot-wall are identical in character with those of the hanging wall and are in places extensively fissured and broken, though usually less so than in the hanging wall. In the hanging wall, in addition to much irregular fracturing, two sets of fissures may be distinguished, one approximately parallel to the Bunker Hill fissure and the other nearly at right angles to it.

"The zone of fissured quartzite in which the orebodies occur has a maximum width of 300 ft., measured perpendicularly to the Bunker Hill fissure. Within this zone, here in contact with the foot-wall, there separated from it by barren quartzite, are numerous irregular orebodies, usually without definite walls or boundaries. Locally, however, the ore may be bounded on one side by the clay gouge of the Bunker Hill fissure or on one or more sides by some of the subsidiary hanging-wall fissures. . . It is difficult to convey a satisfactory idea of the dimensions of orebodies so lacking in regularity. Individual pay-

²The Geology and Ore Deposits of the Coeur d'Alene District, Idaho'.

³Which of the "quartzites"? We have been informed that the lode is in one formation, the Revett quartzite.

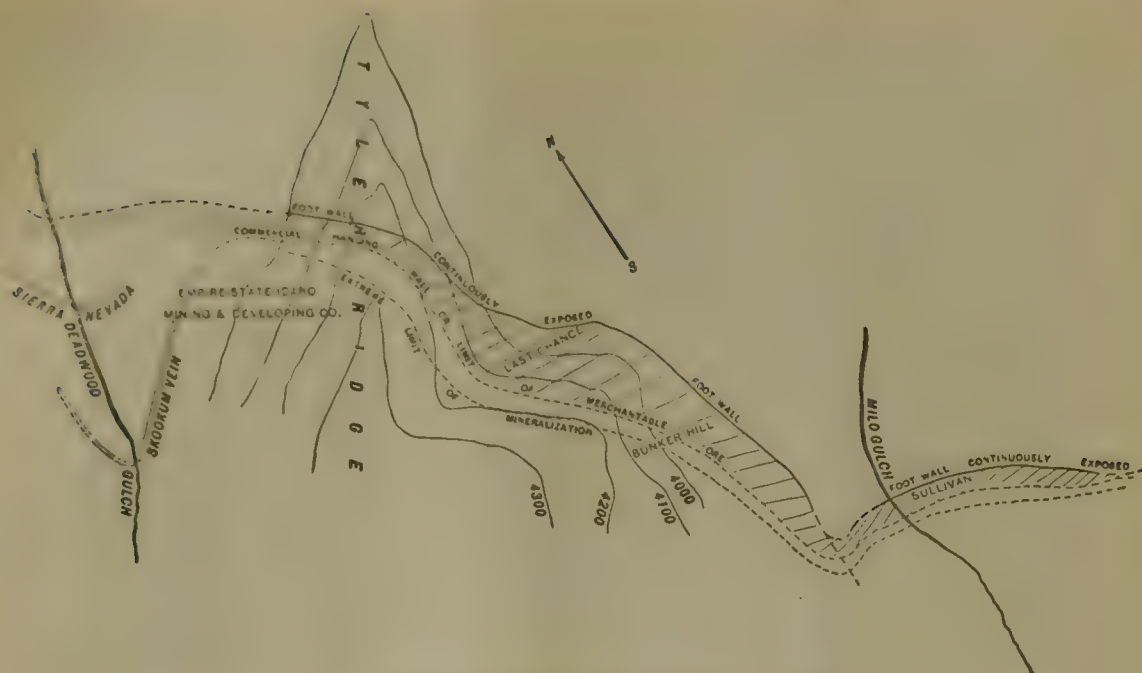


FIG. 1. PLAN OF THE BUNKER HILL LODE. By J. R. Finlay

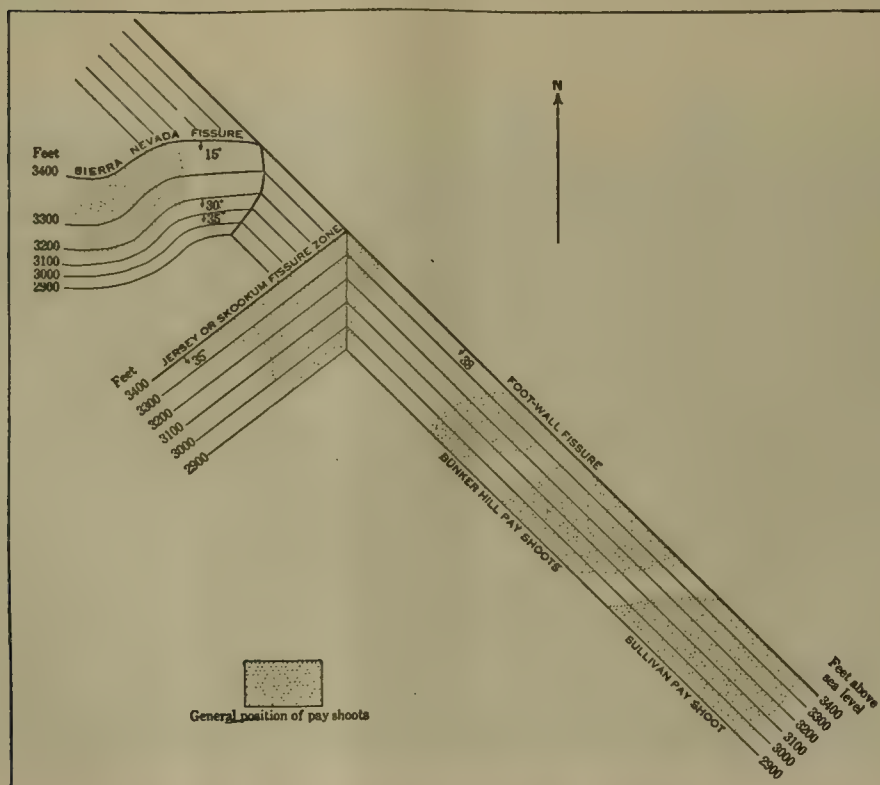


FIG. 2. STEREOGRAM SHOWING THE GENERAL RELATIONS OF THE PRINCIPAL FISSURES AND ORE-SHOOTS OF THE WARDNER GROUP OF MINES. By F. L. Ransome

shoots may be 500 ft. in length, 100 ft. or more in width, and 300 or 400 ft. in depth. The whole fissured zone, 300 ft. in width, may, in a broad sense, be regarded as a single great lode, within which the partly overlapping and partly connected orebodies are not uniformly distributed in the plane of the zone but are grouped into at least four fairly distinct shoots."

Then follows a brief description of the several ore-shoots. I shall quote only one paragraph more.

"The orebodies of the Bunker Hill & Sullivan mine are usually of entirely irregular form and the longest diameter of the body may lie at any angle with the Bunker Hill fissure. The absence of definite limiting walls to the ore is a characteristic although not invariable feature of these large bodies. Masses of nearly solid galena grade outwardly into ore containing larger proportions of gangue and finally into barren country-rock. Here and there, however, the ore ends abruptly at a fissure whose walls show evidence of some movement since a part at least of the galena was deposited. Such a fissure, for example, forms a local hanging wall to part of the large March orebody on the Kellogg level. Similar fissures in some places traverse the orebodies, and the ore forming their walls is usually slickensided. Nowhere, however, are the fissures important faults. Some orebodies rest directly upon the foot-wall of the Bunker Hill fissure and are slickensided, showing that movement along this fissure has continued since the ore was deposited."

This geologic diagnosis shows but little advance on that of Mr. Finlay, despite the much greater facilities for investigation and research available to the gentlemen of the Survey. Both describe a wide zone of shattered quartzite adjoining a strong fissure, from which the orebodies extend irregularly into the hanging-wall rock. The important part played by a number of other fault-fissures is not recognized, and it cannot be said that the scientific information published by Messrs. Ransome and Calkins was of any practical value to the management of the mine. Fortunately, further geologic guidance was forthcoming from another source. An apex suit between the Federal Mining & Smelting Company and the Bunker Hill & Sullivan Mining & Concentrating Company called for intensive investigation of the local geology. For this purpose, the Bunker Hill company engaged Oscar H. Hershey in the fall of 1908. He proceeded forthwith to make a geological map of the area, about 3 by 4 miles, called the Wardner quadrangle. Mr. Calkins had examined this area, but not to his own satisfaction, for he says: "The structure is most complex and also most obscure in the quartzitic rocks near Wardner. Here the mapping must be considered as greatly generalized." It was; whereas Mr. Calkins identified five faults within this area, Mr. Hershey identified and named no less than 40, and recognized others of minor importance. This was the result of six weeks of steady work. He published⁵ the map embodying his observations in 1912, after the

lawsuit was ended. With the map he gave a description in which the principal rock formations traversed by the Bunker Hill lode are given as follows:

	Ft.
St. Regis	1000
Upper Revett	900
Middle "	100
Lower "	1300
Upper Burke	2000
Lower "	1500

It will be noted that this makes a total of 5800 ft., as against the 4200 ft. in the general section of the U. S. Geological Survey. Mr. Hershey estimates the total thickness of the Algonkian system at 19,800, as compared with the 17,200 ft. of the Survey. Such igneous rocks, in dike form, as he has noted in the district have, he says, "no apparent genetic connection with any ore deposit and are probably much younger than most of the ore". So they play no part in the discussion, which is concerned chiefly with the faulting, and later with the source of the mineralization either in the sedimentary beds from which the quartzite series was formed or the suspected underlying mass of igneous rock.

Mr. Hershey continued his survey of the Wardner district and by 1909 he had mapped 97 faults. His work underwent competent criticism, without suffering in the process. In 1916 J. B. Umpleby and E. L. Jones Jr. of the U. S. Geological Survey undertook to re-map this area, but they encountered so many difficulties, chiefly that of discriminating between the formations, that they dropped the project. I take pleasure in reproducing Mr. Hershey's map, which is a record of careful and intelligent investigation, of a kind only too rare.

We have seen how previous observers had emphasized the Bunker Hill fissure as the main line of departure for the mineralization. Mr. Hershey identified this 'Wardner foot-wall', as it was known locally, with a fault named the Lower Cate. Eastward and downward it diverges from the foot-wall of the lode and crosses it to the hanging wall. In large part it is roughly parallel with an older fault, into which it merges in places. Both faults were disclosed in the lower workings of the mine, so that Mr. Hershey labeled the upper fault the Upper Cate and the younger and lower one the Lower Cate.

A feature stressed by Messrs. Ransome and Calkins, as well as by Mr. Finlay, was the absence of a definite hanging wall. Indeed, the courts, in the course of apex litigation, adopted this idea. For example, in *Last Chance v. Bunker Hill & Sullivan*, 131 Fed. 579, the finding of the Master was "that the Bunker Hill lode has no physical hanging wall, no marked line complement to the foot-wall, in defining the limit of the fissure; that for its underlying boundary it has a well-defined, continuous bed of quartzite, but for its overlying boundary it has only an irregular and vague outline of the limit of mineralization, from which fact, and the peculiar geological formation of the lode, it is very difficult to define this limit with any degree of certainty, for which reason much confusion and some contradiction appears in the testimony upon this point; that the weight of the testimony

⁴Page 66, Op. cit.

⁵M. & S. P., June 1, 1912.



FIG. 3. OPEN-CUT ON BUNKER HILL FISSURE (By courtesy of U. S. G. S.)

f, foot-wall; g, crushed quartzite and gouge; h, fissured quartzite of hanging wall



(By courtesy of U. S. G. S.)

FIG. 4. BUNKER HILL FISSURE AS EXPOSED ON SECOND LEVEL OF LAST CHANCE MINE

h, hanging-wall quartzite, much shattered; g, dark band of gouge; w, white seam of crushed quartzite; f, foot-wall quartzite

shows, however, that the mineralization usually fades in value until a point is reached 350 ft. or 400 ft. out, where the rock is practically barren". Of course, the "continuous bed of barren quartzite" constituting the foot-wall is not accepted as a correct description, for Mr. Hershey's map and the evidence obtainable underground unite in proving the contrary, namely, that the lode-channel transgresses the bedding-planes, which themselves are dislocated by numerous faults. It is now known, moreover, that before the limit of mineralization is reached, there is an increase of it, almost to the point of making 'ore', in the crushed rock of the Buckeye fault. This interpretation was adopted by the geologists on the side of the Bunker Hill in the later lawsuit with the Federal company over the Last Chance ground, but the case never came to trial, the dispute being settled otherwise in 1910, the Bunker Hill company coming into the possession of this adjacent mine peaceably. Mr. Hershey was retained as consulting geologist, an appointment that he still holds. This fact would appear to indicate the value set by the management upon his investigations and the advice based thereon. As editor I was glad, in 1912, to publish his treatise on the origin and distribution of the silver-lead ores in the Wardner district in the form of three successive articles,⁶ which were re-printed in pamphlet form. Mr. Hershey summarizes his hypothesis for the origin of the ore, as follows: "The lead, silver, and zinc minerals of the Wardner district were originally disseminated through certain bands of the Belt sediments; were first concentrated into the visible disseminated zinc and lead deposits through the action of the heat and probably water emanating from a monzonite magma; and were then concentrated into commercial ore-bodies by hot waters that were forced to ascend by the compressive stresses that produced the thrust-faults, these thrusts opening the fissures in connection with which the ores have been deposited. The ores of each successive stage have probably been derived in part from those of earlier ore-forming stages, in part from the visible disseminated deposits, and in part from the original minute disseminations in the sediments."

Against this must be placed Mr. Ransome's hypothesis, as set forth in Professional Paper 62, already quoted. He says:

"The mineralogical character of the ores indicates that the depositing solutions were hot and under high pressure. Fissures . . . are rarely sufficient as channels for ordinary cold underground water to effect the intense local concentration of metals generally distributed through the rocks in quantities too small to be detected by the ordinary methods of chemical analysis. . . Two factors, fissuring and the presence of igneous rock, have been shown to be almost universally present and in most districts are undoubtedly genetic conditions of prime importance. Other determinative factors are to be found in the character of the country-rock and in its attitude or structure, especially with reference to intrusive masses.

In view of these general and preliminary considerations, the possible relation between the Coeur d'Alene ores and the intrusive masses of monzonite . . . invites attention."

These are shown on the geological map, but as the nearest of them is eight miles from Wardner and the distribution of ore "shows no obvious symmetry" with reference to them, Mr. Ransome acknowledges that they may "appear inadequate to account for" the ore deposition. He points out, however, that the exposures of monzonite represent merely the eroded tops of larger masses that may unite in depth and it is possible that the erosion of a few thousand feet more of rock "would probably expose a large area of monzonite in the central part of the district, with smaller outlying areas where at present no intrusive rock is shown". Here I may interpolate that 'monzonite' is a granitic rock of porphyritic habit, that is, it has a granular texture and is speckled by a characteristic mineral—in this case, feldspar. It is a rock associated with many famous ore deposits, for example, the Utah Copper, at Bingham. Mr. Ransome says furthermore:

"It is not supposed that the ores were derived from the comparatively small bodies of monzonite now exposed in the district. These themselves show some mineralization, as at the Sunset mine, where the monzonite is speckled with pyrite, and they may have entirely solidified before the principal mineralization was effected. The source of the ores is thought to lie in the underlying batholith from which the exposed masses are probably offshoots." 'Batholith' is derived from two Greek words meaning 'deep' and 'stone', and is a term given vaguely to suspected masses of igneous rock underneath the outer crust of the earth. "Underlying" as used by Mr. Ransome is redundant. In developing his magmatic hypothesis—it is hardly a 'theory'—he says that "as there is no thermal activity in the region at present, this magmatic reservoir has probably solidified as a monzonitic or granitic rock. A long period may have elapsed, however, between the cooling of the parts now visible and the crystallization of the whole mass. The occurrence of the Coeur d'Alene ores appears to furnish one more example of the remarkable dependence of mineralization on the intrusion of monzonitic rocks in the Cordilleran region."

After Mr. Hershey had published his paper in the 'Mining and Scientific Press', Mr. Ransome replied to sundry implied criticisms.⁷ He drew attention to the fact that he and Mr. Calkins had been able to devote only a short time to the study of the Wardner district as compared with Mr. Hershey, who had not only their report on which to start his own investigations but also the advantage of continued observation of the exploratory work done in the Bunker Hill mine; and he protested politely against "the probably unintentional disparagement" of the work done by "those who first gave a comprehensive account of the geology and ore deposits of the district". This must have amused many mining engineers who have suffered at the hands, or pens, of the geologists of the

⁶'Genesis of Lead-Silver Ores in Wardner District, Idaho'. 'M. & S. P.', June 1, 8, and 15, 1912.

⁷'M. & S. P.', August 3, 1912.



Survey in exactly the manner suggested. The first study of the economic geology of our Western mining districts has usually been made by mine managers and local geologists, who not uncommonly have written papers on the subject for the Institute or for the technical journals. When, in due time, the gentlemen of the Survey have come to a district to make a scientific study of it, they have had the benefit of the pioneer investigations recorded by others possibly less learned but certainly quite as conscientious; they have been enabled to do their work with all the resources of a scientific bureau at their disposal, and they have prepared monographs and professional papers of recognized value, but marred, in my opinion, by an ungenerous treatment of the pioneer investigators whose spade-work has been so helpful to them in driving a scientific furrow of larger scope and greater precision. Long ago John A. Church referred to "the usual self-sufficiency of the officers of the U. S. Geological Survey" and I can recall several instances in which they have referred to the precedent studies of mining engineers only for the purpose of emphasizing minor points of disagreement. Moreover, they have had the habit of frequent reference to the writings of their own confreres while making scant mention of those of non-official geologists, whose writings have been distinctly useful to them in preparation of their more elaborate treatises. Therefore we smile when Mr. Ransome, in this case, acknowledges where the shoe pinches. Mr. Hershey had exactly that advantage, of later and fuller investigation, that is usually the privilege of the Federal geologists, and if he was enabled thereby to criticize and correct effectively, we accept the position as entirely in accord with the eternal fitness of things.

Mr. Ransome re-states his own hypothesis thus: "The fissuring of the district was due to stresses set up during the intrusion and solidification of the great quartz-monzonite batholith of central Idaho, of which the exposed monzonite masses in the Coeur d'Alene district are probably offshoots, and . . . the ore constituents, inclusive of the siderite but probably exclusive of some of the quartz, were given off as emanations from the deep-seated portions of the slowly crystallizing batholith. Among the facts adduced in support of these conclusions was the mineralogical connection, through deposits of intermediate character, of the orebodies of the Wardner type with others in the same region that are genetically connected with contact metamorphic action."⁸

Concerning Mr. Hershey's hypothesis, he says that it is "both novel and ingenious, but while it would be unfair to expect him to marshal all his significant facts [why not?] in a short paper, nevertheless his presentation, in view of the work previously done in the district [and acknowledged to be sketchy], appears deficient in evidence". I shall not discuss further this question of the origin of the ore; it seems to me that the rival hy-

potheses are equally interesting and equally undemonstrable for lack of sufficient evidence; nor does it matter to the miner whether the valuable mineral came from the batholith or from the sediments above that batholith; what the miner wants to know is something about the final concentration of the mineral into masses that he can exploit profitably. This last stage of concentration appears to have been influenced chiefly by structural conditions, in the form of faults and fissures. It is the position and relation of these that Mr. Hershey has worked out with so much pains and success. His map has served as a chart for prospecting in the Bunker Hill mine. The use of it has led to the finding of ore, and thereby it is confirmed as a valuable contribution to the geologic diagnosis of the district.

MINERALOGY. The composition of the ore is important to the metallurgist, to whose work we shall come in a later article of this series. The ore is composed of quartzite enriched by silver-lead minerals. The quartzite consists of grains of quartz cemented by quartz and sericite, together with some secondary siderite. Sericite is a silky hydrous mica resembling talc. Siderite is the carbonate of iron; it varies in color from white to dark yellow. Not only does it exist as a secondary constituent of the altered country-rock forming the matrix of the ore, but it is an important associate of the valuable minerals, that is, those of the silver and the lead. In the Bunker Hill lode the siderite is the principal gangue-mineral, much of the ore consisting essentially of a mixture of siderite and galena, the rich ore containing a major proportion of galena, whereas in the poorer ore the siderite is reticulated by minute veinlets of galena. This structure renders it difficult to separate the valuable mineral, the galena, from the valueless gangue, the siderite, except by fine grinding, as we shall see when the milling process is described. The galena is fine-grained, as compared with that of other lead-mining districts, such as those of Missouri. Some of it is so fine-grained as to be called 'steel galena' by the miners. When it oxidizes, it changes to cerussite, the carbonate. The sulphate (anglesite) is rarely detected in the Bunker Hill ore. A little tetrahedrite, the gray sulphide of copper, has been found in the Sullivan and Tyler workings, but it is rare. Native silver has been found on the upper levels, but the silver that forms so important a product is present in chemical combination with the galena, and therefore is not discernible to the eye. Fine-grained iron pyrite is disseminated throughout the lode-channel and also in the filling of the fault-fissures, but, on the whole, the Bunker Hill lode may be said to be remarkable for its small proportion of pyrite, as compared with other silver-lead deposits. The chief feature is the large proportion of the carbonate of iron. In this respect the Bunker Hill lode is generally regarded as unique, for, although siderite occurs in the lead deposits of Wood River, in the Iglesias district of Sardinia, and in the Linares district of Spain,⁹ it is found sparingly in these localities, whereas at Wardner it constitutes as much as half of the lode-matter.

⁸In Professional Paper 62, he made an interesting comparison between the silver-lead deposits of the Coeur d'Alene and those of the Wood River district, as described by Waldemar Lindgren in the Twentieth Annual Report of the U. S. Geological Survey.

⁹Prof. Paper 62, p. 95.

Mining Exploration

By J. H. FARRELL

SUMMARY. The discovery and development of new mines in the Western mining districts is probably not making good the depletion of ore-reserves in operating mines, and it seems likely that in the near future there must be a marked change in the policy of the larger mining companies in regard to the development of prospects.

Exploration companies in the past have done little real exploration or development, having limited their work to the search for developed mines and to mine examinations. Such methods as they have adopted have undoubtedly discouraged prospecting.

State and Federal geological reports do not offer such information as will lead to mine development, and often the publication of such reports is so delayed as to be of no practical value to mine operators.

Owners of old mines and undeveloped properties do not understand the necessity of having complete reports in order to get proper consideration from examining engineers, and it is exceptional to receive accurate and convincing data on such properties.

In conducting successful operations for a development company, the first step should be to make detailed geological surveys in a few districts of proved productivity.

The best development opportunities determined in this way should be thoroughly tested by drilling or by underground work.

Increased incentive to active effort should be obtained by profit-sharing arrangements with the men who carry on the field-work.

The chief requirement for success is that the development company must 'dig' in addition to examining mines.

INTRODUCTION. The discovery of mineral deposits has been a most important factor in bringing about the exploration and settlement of new regions. Michigan and Montana, California and Alaska, would be decades behind their present stage of development had there been no metallic wealth to attract the pioneer. Men went to the new districts and bore the hardship and risk because of the chance of becoming wealthy through successful effort.

Our country has proved so rich in natural resources of all kinds that little thought was given in earlier days to either conservation on one hand, or systematic development on the other. It was rather taken for granted that these resources were practically inexhaustible, and might be made to yield to any methods of exploitation. But in the last few years questions have arisen.

How about the richer iron ores, those which can be sent direct to the blast-furnace? The supply does not look as adequate as it did five years ago. The answer to this question is that there are deposits of low-grade iron ores much more extensive than those of the higher grades now being mined; and these 'lean' ores can be mined and con-

centrated by known methods even in competition with the 'direct shipping' ores.

What of the copper supply when the present great producers, especially the 'porphyry' mines, are exhausted?

Where are we to maintain or increase our production of gold and silver?

The answer to these questions, and I shall try to show why it is the right answer, is more digging.

CONDITIONS IN THE PAST. When California was a new country much gold was won from placer deposits by men whose capital consisted largely of brawn and courage; and many of these men and much of their gold went into the development of 'quartz' mines, until the State became the greatest gold-producing region in the world.

Prospectors traveled eastward into the Sierra and worked their way into the desert country on the other side of the high mountains, and each season saw the location of new mines, and the beginning of new 'stampedes'. It was easy to get help in the opening of bonanza deposits, which required relatively little capital expenditure and yielded rich returns. But as the bonanza deposits grew fewer, and more complex methods were required to treat the ores, mining passed from the control of individuals into the hands of the larger mining companies. Technically trained men were placed in charge of operations and mining was put upon a "more scientific basis". This change had bad phases, along with much that was unquestionably good.

At college we learned the theory of sampling and estimation of ore in mines. We often heard it stated that mining had been reduced practically to a manufacturing basis. In most cases mining engineers were placed in charge of the work of finding new mines; these men had been trained from the start of their professional careers to believe that mine examination is an exact science. They calculated tonnages, value, recovery, working cost, capital requirements, and so on, and decided whether a certain mine could be operated at a profit.

Nowadays the engineers usually decide that the mine cannot be profitably acquired or operated.

The system involving analyses and tape-line decisions is successful in a field where there are developed mines to examine; and there were many such mines at the close of the first period of Western exploitation; mines from which the higher-grade ore had been taken, mines containing ores that could not be treated successfully by old processes, and mines that were made more accessible by improved transportation.

For several years the examining engineers made important finds, and much money for their clients, and some for themselves, until the supply of developed mines began to fail, both in the United States and in the wonderfully

rich Mexican districts. During this period the prospector had a hard time of it. He found a decreasing number of bonanzas, which would attract men willing to gamble on prospects; and a decreasing number of men ready to take prospecting chances. The engineers in charge of 'exploration' for the big mining companies could not be interested in prospects. Their instructions were to find developed mines.

From the copper and iron ranges of Michigan there came men of a more practical type, who undertook successfully the development of some properties from the prospective stage in Arizona. A little later came the most notable development of recent years, that of the low-grade, or 'disseminated', copper deposits, often referred to as the 'porphyry coppers'. Everyone started to look for such mines, and several important discoveries were made. But, although these resulted in greatly increased copper production, and temporarily brought mine development abreast of depletion, they did not help prospecting or exploration work greatly. Formerly, the cry had been: "We must have developed mines." It changed to, "Find us porphyry coppers, or developed mines."

The inventor had been told for many years, "There is practically no risk in taking over a developed mine, where the grade of ore, cost of handling, and profit, can be accurately determined." To this was added the statement, "The low-grade 'disseminated' or 'porphyry' copper deposits offer very large tonnages of ore, which can be cheaply proved by drilling. The subsequent mining and milling are more in the nature of a great manufacturing industry than ordinary mining."

So much for a sketchy description of mine development, and the decline of prospecting in the Western States.

CONDITIONS TODAY. Where are the new mines to be found in the next ten years? We are now a creditor nation, and there should be ample funds for mine development along with other enterprises. Are we to look to Asiatic and South American districts for promising fields? Mexico, of course, has been beyond consideration, and must remain so as long as that country is afflicted with the prevailing chaotic conditions. It is likely that there will be more activity than ever before in foreign fields on the part of American capital, but it does not follow that our resources at home need be neglected.

Let us see what the present situation is.

There are in California, for instance, many regions which have not yet been adequately explored, even by prospectors; there are others which were discovered fifty years ago and which have been almost forgotten. Prospecting no longer appeals to as many men as it did in the past, because the chances of rich surface strikes are necessarily less, and it is much more difficult to get assistance in developing claims.

There are many old mines held idle by estates or heirs who cannot, or will not, work them, and will not sell on reasonable terms. In many cases no reports are available, because owners do not understand the necessity of having accurate and well-presented reports in order to ensure proper examination by engineers representing possi-

ble purchasers. In many districts there are a few more or less discouraged old-timers waiting around for the camp to 'come back'. They hold most of the ground by right of location and annual assessment work, or, in most cases, by re-location and prehistoric assessment work. But these men do not, as a rule, ask excessive prices, and they do know the ground.

THE EXPLORATION COMPANIES. On the other hand are the so-called exploration companies, which do not explore. At least they do not often explore in the sense of sending men or parties into unknown fields to search out mines; they do not usually explore in the sense of doing work on promising outcrops; they do not usually explore by doing new work in the mines examined. What they do, is to examine mines, inspect their workings, sample, scrutinize costs, and determine whether the property under consideration can be purchased without taking any chances on further development. If developed mines are not offered to these companies, their engineers do little but draw their salaries, travel about the country, and keep the executive offices advised as to activities in the various districts they visit.

In many instances no field-work is done; the head of one exploration department made substantially the following statement: "Of course, when I say that we examined over a thousand offers, that does not mean that my men actually visited the properties. By far the greater number were eliminated in the office, merely by reading and studying the reports submitted by the owners or promoters."

Too much "exploration work" is done in that way. An office is unquestionably more comfortable than a shack in a deserted camp; and a swivel-chair is more appealing than the saddle, after a certain stage in life is passed.

Mining engineers are not entirely to blame for the fact that they do not explore or prospect. The men in control of the companies, who usually have little knowledge of field conditions, often impose restrictions that make it impossible for the field-engineer to be anything more than an interested observer. First of all, there is the old demand for developed mines; next, the requirement of large tonnage; one company wants only a smelting ore; another requires ore that will cyanide readily. But the outstanding fact is that the field-engineer cannot do any real mining; he is only there to examine and report. Of course, he draws a satisfactory salary for such work, and if he does not find any mines, he at least builds up a reputation for level-headed conservatism, and finally his function is to prevent the optimistic capitalist from taking any chances with his money!

PUBLICATIONS AND REPORTS. What information is there available to guide the field-engineer in his search?

The U. S. Geological Survey reports are hopelessly general in their descriptions, and their authors, as a rule, carefully refrain from expressing any opinion that might encourage development work. Besides, by the time the final report on a district is published, it is too out-of-date to assist the operator; in some cases districts have been

developed, worked out, and abandoned, before the publication of the Survey's report.

Much of the work in the Western States has been in the nature of hurried reconnaissance, which frequently does more harm than good because the mapping is necessarily sketchy, and may give false impressions of the territory covered.

State surveys are usually modeled upon the U. S. Geological Survey, and the same mistake, of covering too large an area, is often made.

Both State and Federal Surveys concern themselves more with purely scientific problems, and are inclined to neglect those of direct economic importance. The argument is that detailed mapping and sampling cannot be carried out, because it would take too long, or because the owners of mines or prospects would not permit it. In my opinion, greater aid would be given to mining by more complete reports and fewer of them.

As to reports furnished by owners, it is amazing to see the number of utterly worthless documents, supposed to be descriptive of mining properties. How otherwise intelligent men will utilize such material in the endeavor to interest a purchaser, is an inexplicable mystery. The owner usually argues that there is no use in having geological surface and underground maps because they are of minor importance compared to the tonnage of ore in sight, and the statements concerning it which are made in the report. He also maintains that there is no reason to have the property carefully sampled because the purchaser will not accept such sampling in any event. Accordingly he tries to sell his mine without having any idea as to the actual value of the property, or the conditions that exist upon it; and he fails to realize that the plainer the conditions are made to the examining engineer, the better is the chance that the property will be carefully considered. Nor does the average owner consider the fact that by doing a little carefully planned development work he may make the mine look very much more valuable to the examining engineer.

SYSTEMATIC DEVELOPMENT. Much of the foregoing is destructive criticism, and as such will do little to assist the cause of future mining exploration, unless an attempt is made to outline methods of field-work that will be better adapted to the attainment of practical ends.

Anyone who would find a new mine should decide to spend as much time as possible in the field and as little as possible in his office reading reports.

It should be recognized at the start by the men who wish to spend money to find mines, that merely looking at properties will not bring satisfactory results. The organization which undertakes field-work today should not be an 'exploration company'; the name has unfortunate connotation, and should be discarded in favor of the term 'development company', with the implication that the company is formed to dig rather than look. The field-work should be organized more along the lines of a railroad survey. The Chief Engineer goes into the field and directs the location work; he is followed by the young engineers who attend to the routine work of running

curves and cross-sectioning. Similarly, the Chief Engineer of the development company should determine what districts are to be covered by his corps, and what lines are to be followed by the field-work. Then the junior engineers can carry on the work of sampling and geologic survey, which forms the basis for development work.

It is evident that most of the promising areas are known, within which important mineral deposits may be expected to be found in the Western States. The best districts in which to look for new mines are doubtless those in which valuable orebodies have been mined in the past, and intensive examination, based upon geological study, is most likely to produce results.

DIGGING NECESSARY. But it should be emphasized here that no amount of examination, based on geology or anything else, will find mines unless it is accompanied by digging.

It is true that we have learned many things about ore deposits in the last thirty years, but there are many more things that we have yet to learn. A geologist studying an outcrop can outline various possibilities—sometimes probabilities—but it takes digging to prove the case. It is most dangerous to pick up a treatise on metamorphism, or geochemistry, read up a few theories and recitations, and then go out into the hills and try to tell how it all happened. We are so proud of our new science that we are likely to forget that it pays to dig in order to verify it.

The sites of some of the most important discoveries of recent years prove that known productive areas are worthy of careful consideration, and aggressive development work. As instances of this there are the United Verde Extension and the United Eastern mines, both found in districts where strong companies have been mining for many years. The Divide district is close to Tonopah, and the Tonopah companies sent engineers all over the country in search of new properties, but they would not spend money for development near home. The great discovery was made by a man who insisted on digging, in spite of adverse opinions.

Field-work should be concentrated in a given district until the field-engineer is thoroughly familiar with local conditions. There is little to be gained by sending engineers hither and yon, to spend a day or so looking at a particular property in each locality. An old prospector once calculated that in 35 years in the hills he had spent ten chasing his burros; similarly, the average 'scout', or field-engineer, might estimate his time spent on sleeping-cars, or at least in traveling to and from different places.

On a trip to look at a certain mine, little knowledge can be gained of the district as a whole, and that little will probably be entirely superficial. On the other hand, when a district, or a mine, has been carefully studied, it usually is found that there are several interesting development possibilities; and when these have been determined, it is time to start digging to see what they are worth.

The objection will be made that it is risky and expensive to 'carry on such a campaign. The answer is that

such work has been justified by the results wherever it has been attempted on a proper scale. It is only by drilling in promising areas that new oilfields are discovered. In the Mississippi Valley lead and zinc districts, drilling for the extensions of known deposits, or in new districts where the geological conditions are favorable, is the only method of finding new mines, because there are practically no surface indications of the deposits. Such development risks must be taken in the Western districts if new deposits are to be found: and by working systematically on a number of such development projects the chance of success is greatly increased, and one success will pay for a large number of failures.

BIG TONNAGE WITHOUT DEVELOPMENT. Many 'exploration' companies in the past have refused to take over partly developed mines because they were "not big enough".

"What we want," said the director of one of these concerns, "is a mine that we can operate for ten years, mining 500 to 1000 tons per day. And we are willing to pay \$5,000,000 for a developed property. We do not want small mines, nor can we waste time on prospects."

But someone must develop a prospect before a big mine can be made; and no man can look at an outcrop, or a partly developed mine, and say certainly that there is no chance for a big mine. Sometimes the chances seem very much against it, and sometimes one can be practically certain there is no chance. But in many cases there is at least a certainty of profitable operation on a small scale, with good development possibilities.

Many good mines have outcrops that would scarcely be looked at twice, had not some persistent old-timer kept hammering away until he struck it rich.

PERSONAL INCENTIVE. In earlier times the incentive to prospecting was stronger because the individual had a better chance of getting assistance in working a prospect. Today the field-engineer is a salaried employee, who has little chance to get more than his salary if he does find a mine. He may have an opportunity to buy stock to the extent of his resources, but that is all. It is true that this makes for extreme conservatism; it is nearly always safest to report adversely or ambiguously, but adverse reports do not lead to mine development.

More mines would probably be found if the engineers of the development company were permitted to participate in the profits from the enterprise.

How about participating in the losses?

That is something that an engineer holding an executive position always does, if he has charge of an unprofitable operation; and he does so whether he is working for a salary or not. No man of sufficient experience to hold such a position will recommend taking risks that are not amply justified.

LAKE SUPERIOR PRACTICE. No originality can be claimed for the points outlined above. The general method has been in use for many years in the greatest mining district in the country.

The system of mine development in use in the Lake Superior district requires preliminary geological work to

determine the more favorable lines to follow in prospecting; the next step is to verify the results of the initial survey as far as possible by drilling; and the third step is to check the drilling by mine-workings.

It may be argued that drilling into sedimentary formation for iron deposits is much more certain of favorable results than drilling for copper, gold, or silver ores. This is not so evident as it at first appears; the iron-bearing formation does not carry a uniform bed of ore, and orebodies of commercial grade are often much localized, with the result that many blank holes are drilled.

In favor of successful development of Western ore deposits, is the fact that much more may be told from the outcrops, especially in the semi-arid, or desert regions. Similar methods were adopted in the development of the great low-grade copper deposits also; but so far there has been no general application of such a plan of development to other types of deposits in this region.

I do not imply that Lake Superior exploration methods would necessarily be successful in the Western mining districts, but it is certain that in many cases astonishing results would be obtained by well-directed and aggressive development work in areas where there has been little activity since the easily discovered superficial orebodies were exhausted. To name even a few of the districts where such work should be done, and to describe in a general way the existent possibilities, would require a series of separate articles.

It is certain that new mines will only be made by the adoption of such a policy of adequate development work, or briefly: **MORE DIGGING.**

'MANJAK' is a term applied to a variety of bitumen or solid hydrocarbon occurring on the island of Barbados, and in Utah, Cuba, and Trinidad. The deposits on the last island are found within a distance of three miles of San Fernando, the second largest town on the island, and within three miles of the famous asphalt lake. In chemical composition, manjak is like asphalt. It is almost pure bitumen. Its melting point is, however, more than 400°F., whereas asphalt melts at 100°F. In composition, it consists of 80 to 90% carbon, the balance being chiefly hydrogen, with a small quantity of sulphur. It resembles coal in appearance, is odorless, hard, and brittle. It is found in thin beds between layers of clay. The most important use of manjak, and one wherein it has won a reputation for saving money, is in connection with rotary drilling for oil. A soft compound is used on the joints of the pipes between the casing threads and drill stem threads, and this prevents either water, sand, or grit getting into the threads, thus preserving them from being stripped or worn off. It not only acts with particular efficacy in keeping such pipes water-tight, air-tight, and free from corrosion at the joints, but it also facilitates the work of joining and separating the pipes owing to its lubricating qualities. It has been found much superior to white lead or any other substances previously used for such purposes, and its use results in economy.—U. S. Bureau of Mines.

Statistical Review

Production of Base Metals for 1919*

Alaska

GENERAL.—Alaska's developed mineral deposits are chiefly gold and copper; hence her mining industry in 1919 was subject to the same depression that affected gold and copper mining throughout the world. This fact explains in large measure why the value of Alaska's mineral output in 1919 was only about \$18,850,000, according to the preliminary estimate of Alfred H. Brooks, while that of 1918 was \$28,254,000. This is the smallest output of any year since 1910. The value of the annual

worse than ever. These conditions have tended to discourage those who were planning new ventures.

Alaska's Mineral Products in 1919

Gold	\$9,000,000
Copper	8,500,000
Silver	450,000
Coal	350,000
Lead	100,000
Tin	50,000
Platinum, palladium, quicksilver, petroleum, and gypsum	200,000
Total	\$18,850,000

PLACER-MINING.—During 39 years of mining, Alaska has produced gold to the value of \$311,000,000, and \$218,000,000 of this amount is to be credited to her placer-mines. There was less placer-mining in 1919 than in 1918, and the outlook for a revival of the industry as a whole under present economic conditions is not hopeful. In the following table a comparison is made between the placer-mining industry in 1919 and in 1918:

Alaskan Placer-Mining in 1918 and 1919

	—Summer—		—Winter—		Value of output
	Mines	Miners	Mines	Miners	
1919	420	2100	65	275	\$4,790,000
1918	574	3000	153	613	5,900,000
Decrease in 1919	154	900	88	342	\$1,110,000

A most unfortunate effect of the decline in gold, especially in placer mining, is the discouragement of the prospector. Though many prospectors devote their attention to the search for copper and other minerals, they as a class are held to their vocation by the hope of finding rich placers which they can develop by individual effort.

Gold-dredging continues to hold an important place in Alaskan placer-mining. In 1919 there were 28 dredges in operation for the whole or

part of the season; they produced gold to the value of \$1,000,000, compared with an output of \$1,425,000 worth of gold by 28 dredges in 1918. Two of these dredges were operated in 1919 in the Fairbanks district, two in the Iditarod district, one in the Birch Creek district of the Yukon basin, one in the Georgetown district of the Kuskokwim basin, and the rest on Seward Peninsula.

The Yukon placer districts are the most isolated of the important Alaskan mining districts and are therefore the places where the cost of mining is highest, so that they are the most sensitive to present conditions. This fact is reflected in the comparison of their gold output for 1919 and 1918, made in the subjoined table. Fortunately the loss in the Yukon was in part offset by a somewhat greater production of gold at the placer-mines on Seward Penin-



MAP OF ALASKA

output of gold from Alaska declined from \$16,700,000 in 1916 to \$9,000,000 in 1919. The Alaskan gold-mining industry is particularly sensitive to present conditions because many of the enterprises were not on a very sound economic basis; gold production has been kept up for many years by the exploitation of bonanza placers rather than by the systematic development of large deposits of lower grade.

Except for the railroad construction during the year, the transportation conditions in Alaska have been worse in 1919 than in any previous year. The coastal steamboat service has been unable to meet the demand for freight and passenger transportation, and the river steamer service on the Yukon and its tributaries has been

*From preliminary reports of the U. S. Geological Survey.

sula, where considerable activity on a comparatively large scale is recorded.

Placer-Gold Output of Yukon Districts, 1918-1919

	1918	1919
Fairbanks	\$800,000	\$770,000
Iditarod	1,240,000	725,000
Tolovana	875,000	525,000
Ruby	400,000	150,000
Circle (Birch Creek)	175,000	115,000
Hot Springs	150,000	105,000
Koyukuk	150,000	100,000
Marshall	150,000	100,000
Innoko	120,000	60,000
Fortymile	75,000	40,000
All others	129,000	140,000
	\$4,264,000	\$2,830,000

The placer-gold output of the Fairbanks district was produced by 36 summer mines employing 360 men, and 20 winter mines, employing 80 men. Drift mining is on the wane at Fairbanks, for in 1918 there were over 40 deep mines and in 1919 there were only 28. Mining in the Iditarod district, except that done by the dredges, is decreasing year by year. Much of the rich placer ground has been worked out, and the isolation of the district, with the consequent difficulty of obtaining labor and the high freight rates, has not encouraged the exploitation of the placers of lower tenor. The same is true to a great extent of the Tolovana district, where most of the mining has been done by underground methods, but some shallow placers in this district can be developed when operating costs are reduced. Nothing of importance was done in the Hot Springs district.

Except for the discovery of another pay-streak on Poorman creek there was no important advance in the Ruby district during 1919. Placers were discovered on the Hogatza river, in the Koyukuk district, in 1919, but they have not yet been sufficiently developed to determine their value. Placers are also reported to have been discovered in the Birch Creek basin, tributary to Wild river, and also in the Koyukuk district, though these reports have not been verified. These placers are in inaccessible regions and would have to be very rich to justify their development under present conditions. These reports, however, indicate that not all the Alaskan prospectors have become discouraged. The gold production from the Marshall district has been maintained by the output of a few mines working on comparatively rich placers.

Seward Peninsula was the most prosperous of the Alaskan placer-mining regions in 1919; it produced gold to the value of \$1,300,000, compared with \$1,108,000 in 1918. A total of 21 gold-dredges were operated, distributed as follows: 8 in the Nome district, 8 in the Council district, 4 in the Solomon district, and one each in Kougatok, Fairhaven, and Port Clarence districts. In addition to the dredges, about 70 open-cut mines and 13 deep placer-mines were operated.

GOLD-LODE MINING. Eighteen gold-lode mines were operated in Alaska in 1919 and produced gold worth about \$4,100,000. Twenty-five mines were operated in 1918 and produced gold worth \$3,473,000. The increase in 1919 came from the three mines at Juneau, but does not assure the continued prosperity of the lode-mining industry, for these mines at Juneau are working on too small a margin to make it certain that they will be able

to pay the continued increasing expense of mining. The only other large gold-lode mine in Alaska is in the Sitka district, where operations in 1919 were, so far as known, on about the same scale as in 1918.

The most important event of the year bearing on lode mining in Alaska was the development of some large ore-bodies in the Stewart River basin of Portland Canal, which marks the south-eastern boundary of the Territory. So far as known, the only properties developed sufficiently to prove the value of these bodies are on the Canadian side of the International boundary, close to it. The same geologic conditions occur on the Alaskan side of the boundary, where metalliferous lodes have long been known to occur and where many claims have been staked. The natural seaboard outlet for the Canadian as well as the American properties in the Stewart River basin is the town of Hyder, on the Alaskan side of Portland Canal. The lodes of this district, so far as known, consist of (1) disseminated deposits in fracture zones, and (2) vein filling in well-defined fissures. Excitement has recently been caused by the finding of auriferous lodes carrying large quantities of silver. Galena, tetrahedrite (gray copper ore), pyrrargyrite (ruby silver), and native silver, are said to occur in these ores. There is reason to believe that similar deposits may occur in the Alaskan side of the Stewart River basin.

The small lode operations in 1919, several of them no more than prospects from which a little ore is being taken, are distributed as follows: One each in the Ketchikan, Chitina, and Kenai Peninsula districts; five in the Willow Creek district; and six in the Fairbanks district. The most active prospecting and development of gold lodes in 1919 was in the Willow Creek district, which lies adjacent to the railroad, where, however, no property has yet been opened and equipped on a large scale.

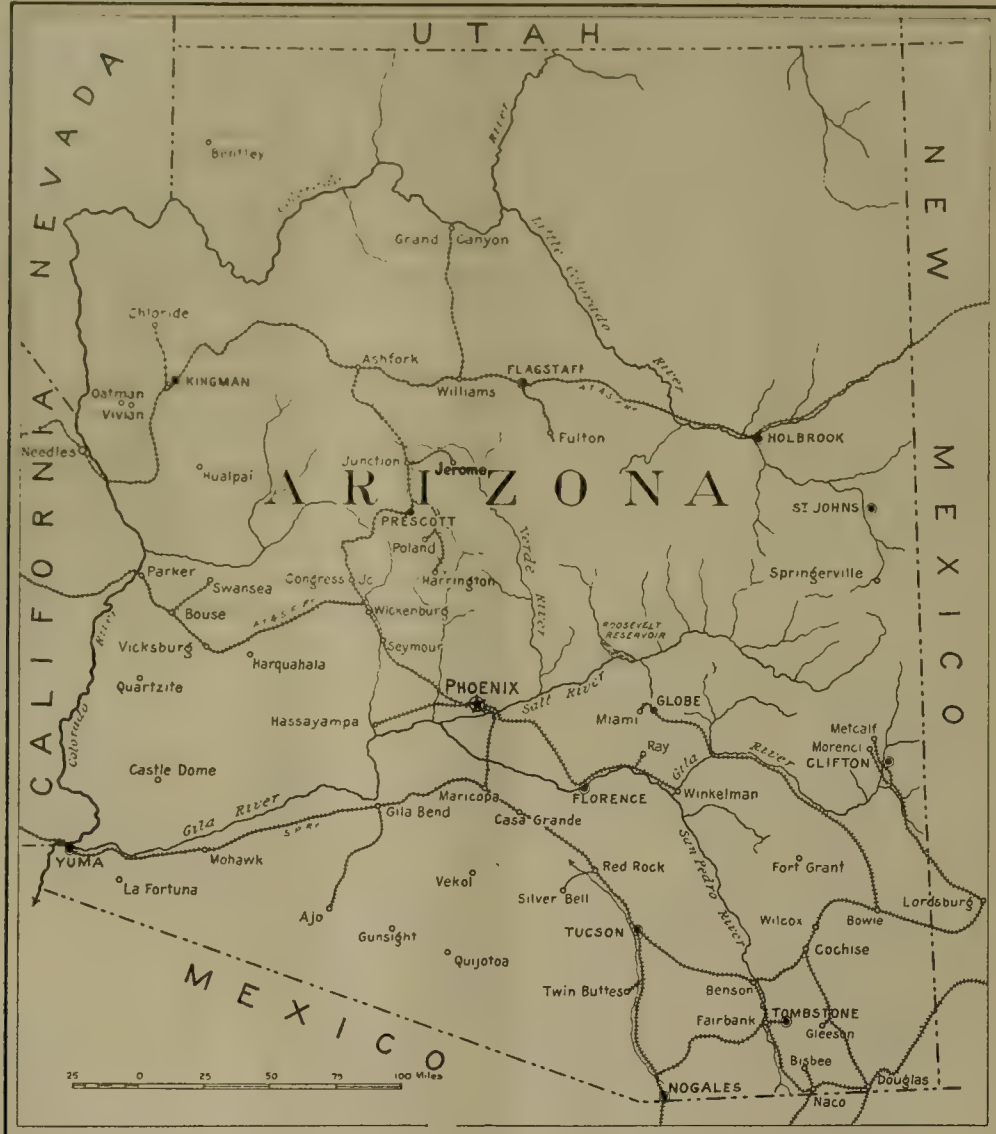
COPPER.—Eight copper mines were operated in Alaska in 1919, producing about 44,800,000 lb. of copper, valued at \$8,500,000. The production of copper in 1918 was 69,225,000 lb., valued at \$17,099,000, and came from 17 mines. This curtailment of copper mining was due to the fall in the price of copper and the uncertainty of the market, as a result of which the larger mines decreased their output and many of the small ones closed down.

Most of the prospecting for copper in 1919 was done in the Susitna basin, tributary to the Alaska railroad. A number of copper lodes of some promise have been found in this region, but they have not been sufficiently developed to prove their value. In south-eastern Alaska the Rush and Brown mine was the largest copper producer. Copper was also produced at the Salt Chuck mine, better known for its output of palladium. The three large mines, Bonanza, Jumbo, and Mother Lode, of the Kennecott group, were the only producing mines of the Chitina district in 1919, though some development work was done on other properties. On Prince William Sound the Beatson-Bonanza and Ellamar copper mines were the only properties worked systematically.

MISCELLANEOUS METALS. Most of the silver and lead produced in Alaska has been won as a by-product in

mining gold and copper. Silver-bearing ore in the form of galena is widely distributed in Alaska, but until two years ago was little heeded. Since then the high price of silver has led the prospectors to search out some of the galena lodes, and as a consequence some promising discoveries have been made. The development of silver-

in 1919, two dredges and one small open-cut mine were operated on placer tin, employing some 25 men. No new deposits of placer-tin have been discovered in the York district in recent years, and there is no certainty that this form of tin mining will be continued there when the deposits now being exploited are worked out.



MAP OF ARIZONA

bearing lodes in the Canadian part of the Portland Canal region has already been referred to.

The silver output of Alaska in 1919 was about 590,000 oz., of which some 500,000 oz. was recovered from copper ores. Alaska's lead output of 1919 is estimated to be 800 tons, practically all a by-product of the gold-lode mines.

The York district, of Seward Peninsula, continues to be the centre of the tin-mining industry of Alaska. Here,

Some platinum was recovered in the mining of placer gold in the Seward Peninsula, Tolstoi, and Chistochina districts in 1919, but the quantity is unknown. The mining of copper ores at the Salt Chuck mine, in the Ketchikan district, which carry palladium and platinum, was continued, as in the previous year. There was no production of tungsten, antimony, or chromite in 1919, and development work on properties carrying these minerals was practically stopped. Productive mining was

continued on the quicksilver deposit on the lower Kuskokwim river.

Arizona

The output of gold, silver, copper, lead, and zinc from mines in Arizona in 1919, according to the estimate of Victor C. Heikes, had a total value of about \$108,707,000, a decrease of \$93,427,880 from the figures for 1918. Although there was a decrease in both quantity and value for all these metals, the largest decrease was for copper. During the first part of the year, there was a marked curtailment of output, and in the Verde district labor troubles closed the mines for nearly four months. During the last three months of the year many of the large companies again curtailed production as a result of market conditions.

GOLD. The production of gold decreased from \$5,435,027 in 1918 to \$4,231,000 in 1919. This decrease, \$1,204,000, was a result of the general curtailment in the production of copper ore. More than half the output of gold from Arizona came from the gold ores of the San Francisco district of Mohave county, although there was a decrease from this source as well as from the copper ores. The United Eastern Co. remained the largest producer of gold in the State, and the Tom Reed Co. continued its large output. The Copper Chief mine, in the Verde district, and the Gold Road mine, at Oatman, were idle.

SILVER. The mine output of silver decreased from 6,686,152 oz. in 1918 to 4,927,000 oz. in 1919. In spite of the increase in the price of silver the value of the output decreased from \$6,686,152 to \$5,479,800. The largest producers of silver were the Calumet & Arizona, Copper Queen, United Verde, Magma, and United Verde Extension mines. Outside the copper mines, the largest producers of silver were the Bunker Hill mine at Tombstone and the Commonwealth mine at Pearce.

COPPER. The mine output of copper decreased from 764,855,874 lb. in 1918 to 522,000,000 lb. in 1919, a decrease of nearly 32%. The value of the output decreased from \$188,919,401 in 1918 to \$98,296,000 in 1919, and the average price of copper decreased from 24.7c. to 18.83c. per pound. There was a decrease in the output of each of the smelting plants in the State, except the United Verde Extension smelter at Verde. At Miami the output of the International plant came near the record of 1918. The Shannon smelter at Clifton was closed in January, and the plant at Sascos was closed early in the year. At Ajo the New Cornelia Copper Co. continued the leaching of copper ore, but its output was reduced about 20%. In the Warren district development work opened extensive orebodies on the Denn Arizona ground and on leases on Copper Queen ground.

LEAD. The mine production of lead decreased from 12,503,689 lb. in 1918 to 10,000,000 lb. in 1919. The value of the output decreased from \$887,762 to \$575,000. Large shipments of lead were made from the Shattuck mine, in the Warren district, in spite of the delay caused by a fire on the 800-ft. level in March. In Pinal county

the property of the Ray Silver-Lead Co. produced considerable lead ore, though less than in 1918.

ZINC. The output of recoverable zinc decreased from 2,269,643 lb. in 1918 to 1,717,000 lb. in 1919. The value decreased from \$206,538 to \$125,700. The Arizona Hillside Mining Co., in Yavapai county, was the only important producer.

Dividends from Arizona mining companies during the first 11 months of 1919 amounted to \$19,841,000, exclusive of those of the Phelps Dodge Corporation, which also operates mines in Mexico and New Mexico. Including the dividends of the Phelps Dodge Corporation, the total was nearly \$26,816,000. The companies that paid dividends were the Miami, Inspiration, Iron Cap, Shattuck, United Eastern, United Verde, United Verde Extension, Arizona Copper, Calumet & Arizona, Magma, Ray Consolidated, Arizona Binghamton, and the Phelps Dodge Corporation.

Washington

The value of the gold, silver, copper, and lead mined in Washington in 1919, according to the estimate of C. N. Gerry, was about \$959,000, a decrease of \$518,000 from that of 1918. No zinc ore was marketed. There were marked decreases in copper and lead, and slight decreases in gold and silver. The copper output in the Chewelah district, Stevens county, was somewhat less, and there was a marked decrease in the shipments of silicious ore from the Republic district, in Ferry county. Most of the ore and concentrate from the mines of Washington was smelted at Tacoma, Wash.; Trail, B. C.; Midvale, Utah; and Northport, Wash. The plant at Grand Forks, B. C., was closed in June, and the smelter at Greenwood, B. C., was idle throughout the year. The lead plant at Northport, Wash., was idle several months on account of the inactivity of the Hercules mine in Idaho during most of the year. The price of silver increased to about \$1.12 per ounce, but the average prices of copper, lead, and zinc were even less than those of 1918.

GOLD. The mine production of gold decreased from \$304,658 in 1918 to about \$280,000 in 1919, a decrease of nearly 8%. Nearly all the gold came from the Republic district, and there was a distinct decrease in ores amalgamated throughout the State. From the Republic district approximately 25,600 tons of silicious ore was shipped during the year, as compared with 42,275 tons in 1918. The mines of the district were closed on October 9, as a result of a labor strike. The principal shippers from the district were the Last Chance, Quilp, Knob Hill, San Poil, and Lone Pine mines. The Quilp mine, which had been idle for years, produced the largest output of gold. The Lone Pine-Surprise-Pearl group, which was formerly the largest producer, was idle during most of the year.

SILVER. The mine output of silver decreased from 310,093 oz. in 1918 to approximately 299,000 oz. in 1919. The value of the output increased from \$310,093 to about \$333,000. Nearly half the silver came from copper ores, and most of the remainder from ores from the Republic

district. The Consolidated Mines Co., in the Springdale district, made several shipments of silver ore.

COPPER. The copper output decreased from 1,922,406 lb. in 1918 to about 1,321,000 lb. in 1919. The value of the output decreased from \$474,834 to \$248,700. The United Copper mine, in the Chewelah district, was as usual the largest producer of copper. Ore rich in silver was mined below the 1300-ft. level, and shipments of crude ore and concentrate averaged about 350 tons per month. Other notable shipments of copper ore came from the Sunset mine, near Index, in Snohomish county, and the Loon Lake mine, north of Spokane, where a new flotation plant was operated.

LEAD. The mine output of lead decreased from 5,271,815 lb. in 1918 to about 1,700,000 lb. in 1919. Most of the product came from the Electric Point property, near Northport, in Stevens county, which was idle most of the year. As the company resumed mining in November, the output is largely estimated.

The only dividend paid by a metal mine in Washington during the first 11 months of 1919 was that of the Electric Point mine, which amounted to \$23,790.

DOMESTIC EXPORTS of mining machinery, exclusive of oil-well equipment, from the United States during November 1919, were as follows:

Destination	Value
Denmark	\$185
France	3,706
Norway	2,233
Spain	918
Turkey in Europe	925
England	205,311
Canada	57,068
Honduras	227
Nicaragua	2,232
Salvador	586
Mexico	135,831
Newfoundland	995
Cuba	2,149
Dominican Republic	8
Bolivia	2,279
Chile	60,072
Colombia	13,514
Ecuador	398
Peru	18,184
China	145
Chosen	610
British India	100
Dutch East Indies	28,693
Japan	7,014
Siberia	820
Siam	1,025
Australia	1,415
Philippine Islands	10,690
Belgian Kongo	580
British West Africa	969
British South Africa	20,191
Portuguese Africa	389
Total	\$579,462

COPPER PRODUCTION in Norway amounts to about 3000 tons in ordinary years, half of which is produced at Sulitjelma and the rest about equally from the mines at Røros, Birtavarre, and Christiansand. In 1918 about 600 tons of copper was produced in the Norske Extraction Works at Fredrikstad. Notwithstanding this latter addition to the ordinary production the total output for the year amounted to only about 2200 tons. Although copper has been selling in the United States cheaper than it can be produced in Norway, owing to the fact that the importation of copper was almost wholly stopped in 1918, the Norwegian output commanded a high price, and on

the whole the copper mines enjoyed a year of unusual prosperity.

Blasting Accidents From Missed Holes

*Accidents caused by missed holes occur both underground and in open-cuts. Many of them are avoidable. The following report of an accident, occurring in some open-cut steam-shovel work, in which two men were killed, should serve as a warning in operations where any uncertainty exists about a missed hole and where black powder is being used. The accident referred to occurred in an open-pit copper mine in Utah.

The height of the face at the cut is about 30 ft. Twenty 1½-in. vertical holes 30 ft. deep were drilled at the time and chambered with about 50 sticks of 1½-in. dynamite. They were then loaded with 8 or 10 cans of black powder in each hole and exploded with an electric battery, after which the debris was removed by a large steam-shovel. At the time of the accident the dipper was working on the right side of the cut, the boom being turned to the right. The engineer and craneman were in their places, both being on the right-hand side toward the shot. When the dipper was just starting at the grade, to take a load, a flash was seen, followed by an explosion a few seconds later. Most of the men ran under the shovel, two or three did not quite get out of danger and were slightly hurt. The positions of the engineer and craneman were such that there was no chance for them to escape. The engineer's body was found lying on the cab floor, and the craneman's body was found between the cab and boom beam, both being killed by the fall of blasted rock.

This seems to be a clear case of a missed hole that was exploded by sparks from the steel dipper. One of the pitmen said they all saw a flash and ran for the shovel.

The formation at the surface is full of cracks and crevices; also, the springing of the holes would open cracks. The explanation of the cause of the accident is that, when loading the black powder, some of the powder ran down one or more of these cracks and filled a small opening not far from the loaded hole, at the same time leaving a trail of powder from one point to the other. This explains the lapse of time between flash and blast. Sparks from the dipper just as it reached the powder caused the trouble.

The foreman and the pitmen all say they often see unexploded black powder in small quantities among the rocks, but that no flash has been seen before; also, that this was the first missed hole they have known of, though most of these men have been on the job only a month or two.

This accident emphasizes the necessity of careful search of any place where blasting has been done for evidence of missed holes. In the cases where black powder is used the injection of water would serve as an effective preventive of an explosion.

*From Reports of Investigations, Bureau of Mines.

Detonating Dynamite

Four methods are at present in use for detonating dynamite: the blasting cap in combination with safety fuse, the electric blasting-cap, the delay electric blasting-cap, and the delay electric igniter in combination with the blasting-cap. To these may be added Cordeau, which is a 'detonating fuse', but whose cost is so high as to preclude its use in anything except deep-well drill-holes or similar projects where very large charges of explosives are contained in a single hole. Hence it will not be considered in this instance. Consideration of these on the different points characterizing the ideal method, reveals the fact that, with the same strength of blasting-cap, they are all about equal in securing the full energy from the charge of dynamite in the hole. With the blasting-cap and fuse, it is possible to fire almost any number of holes in succession or rotation. This is a most desirable feature in sinking shafts or driving tunnels, but it is impossible with this method to explode a number of holes simultaneously so that the charge in one hole will aid that in the next. With electric blasting-caps, however, it is possible to fire a large number of holes simultaneously and to have each charge aid the other. This reduces, to a certain extent, the amount of explosives necessary. Furthermore, in using either electric blasting-caps or delay electric blasting-caps, it is possible to fire three successive series of holes in rotation, with one application of the current and without coming back to the breast or scene of the shooting. By using delay electric igniters with blasting-caps crimped to the end in combination with electric blasting-caps, almost any number of holes may be fired in rotation. The blasting-cap and fuse method is undoubtedly lowest in freedom from misfires, for in addition to the possibility of a misfire due to the fuse alone, there is the added risk that some moisture may enter the cap and cause a misfire. This possibility could be eliminated by water-proofing the crimp. Electric blasting-caps are as free from misfires as are electric squibs. The delay electric blasting-caps, which are self-contained units, are of equal value in this respect. The delay electric igniter to which a blasting-cap has been crimped probably ranks, with respect to freedom from misfires, between the electric blasting-cap and the blasting-cap and fuse, for there is a possibility of water entering the crimp and causing a misfire. As far as the blaster's safety is concerned, the blasting-cap and fuse method is the most unsafe of those mentioned, because it sometimes happens that fuse will smoulder along for a considerable time and then re-ignite the powder train, turning what appeared to be a misfire into a serious accident. Again, when lighting a considerable number of shots in rotation, the blaster sometimes fails to make allowance for the time required to do the lighting and get to a place of safety. An accident is often the result. Another disadvantage is that the blasting-cap must be crimped to the end of the fuse. This in itself presents an element of danger. The same thing is true of delay igniters, to which a cap must also be crimped. The electric blasting-

cap and the delay electric blasting-caps are complete in themselves, and are, therefore, free from a similar hazard. With the electrical method, the blaster can be in a place of safety before attempting to fire the blast. If, upon application of the current, the blast does not follow, he can safely return and investigate the trouble, allowing, of course, a few minutes if any delay electric igniters are used in the blast. As far as the effect of poor storage is concerned, blasting-cap and fuse and the delay electric igniter and blasting-cap are about on a par. Blasting-caps themselves require protection from moisture, and the fuse in both cases requires similar protection. Electric blasting-caps and delay electric blasting-caps, being better protected from moisture by the filling in the copper shell, are not open to as strong objections on this point. They are also not affected by ordinary atmospheric warmth or cold weather. In first cost, the blasting-cap and fuse would probably be the lowest, although there is a point at which a given length of fuse would equal the cost of electric blasting-caps under certain conditions. The electric blasting-cap is a little more costly than cap and fuse. The delay electric igniter comes next, and the delay electric blasting-cap is the most expensive of all in first cost.

Methods for Firing Dynamite

	Blasting-cap and fuse	Electric blasting-cap	Delay electric blasting-cap	Delay electric igniter and cap
Points to be considered				
Full energy from explosive	1st	1st	1st	1st
Freedom from misfires	3d	1st	1st	2d
Relative safety to blaster	2d	1st	1st	2d
Relative resistance to adverse storage	2d	1st	1st	2d
First cost	1st	2d	4th	3d

Summarizing the points mentioned above, the electrical method would undoubtedly be placed first, both for igniting blasting-powder and detonating dynamite, in everything except first cost, and as the first cost might very easily be increased a hundred fold by the amount of explosives lost through misfires or the cost of a single major accident, the conclusion is irresistible that the electrical method of setting off blasts is far superior to any other yet devised.—J. B. Stoneking in 'Du Pont Magazine'.

THE United States produced about 58% of the world's output of talc in 1918 and in addition imported more than 11% of all the talc produced by the rest of the world. As little if any talc was exported, it is evident that the United States is pre-eminently a consumer of talc. Canada is the only competitor for the domestic trade in middle-grade talc. About 12,000 tons, 96% of the talc imported in 1918, came into the United States from Canada. The United States is well supplied with low and middle-grade talc, but lacks high-grade material for use in toilet powder, electric insulators, and gas burners, commonly called lava tips. The talc used for such purposes is imported mainly from Italy and France and, through other countries, from India. Within the last two years a new and interesting source of talc has been found in a large dike of serpentinite in Harford county, Maryland.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

DEVELOPMENT AT PORTLAND MINE.—LESSEES ARE ACTIVE AT LEADVILLE.

CRIPPLE CREEK.—The new orebody at the 2300-ft. level of the Portland Gold Mining Co.'s No. 2 shaft on Battle mountain, found in a cross-vein that was entered 100 ft. south of the shaft, contains from 4 to 5 ft. of one-ounce ore. This is the deepest point at which ore has been discovered in the district. The rich ore-shoot at the 2100-ft. level is situated more than 2100 ft. beyond former known orebodies, indicating the possibility of finding new ore on other levels.

The Vindicator Consolidated Gold Mines Co. reports the discovery, at the 18th level in the Golden Cycle, of the Lillie vein, a part of the Vindicator system. Eighteen inches is sampling from \$15 to \$30 per ton and $1\frac{1}{2}$ in. from 5 to 10 oz. gold.

Mine operations have been commenced by the Lincoln Mines & Reduction Co. on the Magna Charta claims on Ironclad hill, which are owned by the Rex. M. & L. Co. The Lincoln company is operating under bond and lease and has constructed a milling-plant on the group.

LEADVILLE.—Lessees of the New Monarch Mining Co., operating through the Lida shaft in Evans gulch, under Breece hill, have opened up a nine-foot vein of lead-silver carbonate ore, and will soon commence shipping. The dimensions of the shoot have not yet been determined either above or below, but from present indications the shot is a rich one and a carload of high-grade material is ready to be loaded. The Lida has been overlooked for the past 20 years and is now held under bond and lease by Henry Schuck and eight associates, all miners, who have been cleaning out the old shaft and drifts and carrying on exploration work since last April. The vein was not reached until after most discouraging work. The shaft was choked with ice from top to bottom, and for a distance of 300 ft. the drift was filled with caved rock and mud. Perseverance was rewarded and the lessees are drifting on the vein that has been proved by a 30-ft. raise, all in ore. Prior to the closing down of the property 20 years ago, a heavy flow of water handicapped operations, but this water has been practically eliminated by the Yak tunnel pumps.

Lessees on the Dunkin No. 2 and 3, on Fryer hill, adjoining the Matchless, are shipping about 400 tons per month of silicious ores containing silver, and about 250 tons of iron-oxide with some silver content.

Exploration work is in progress in the Green shaft

near Sumptown, at the mouth of South Evans gulch. The Green is surrounded by producers, such as the Big Four, Gold Basin, and St. Louis tunnel, and it is expected that exploration work will open up the extension of the veins found in these mines.

Shipments aggregating 150 tons monthly are sent out from the Robert E. Lee, a famous old silver-producer of the Fryer Hill section. The property is under lease to Frank Zaits and associates who are shipping a silicious ore with fair silver content to the A. V. smelter.

MICHIGAN

COST OF OPENING SENECA PROPERTY.—JANUARY OUTPUT.

An idea of what it costs to open a copper mine in the Michigan district and put it on a producing basis may be gained from an examination of the financing of the Seneca company. The company did not have to prospect as it was reasonably certain that ore would be found. Nevertheless it has expended close to \$3,000,000. This covers original cost of property, promotion, operation, and equipment of plant up to date. The lode has been opened at three levels and the ore has been tested by actual mill runs. Some of the original treasury money is still on hand, perhaps \$200,000. Last week the company announced the sale of \$500,000 worth of bonds and a provision for an additional issue of stock, convertible into bonds. This additional money ought to take care of the further financial outlays that are necessary. The company has announced that it already has contracted for a hoisting-plant capable of handling 5000 tons per day. A production of 2000 tons per day will require a stamp-mill of at least eight or ten heads. The present cost of building a modern mill is \$250,000 per head; so that a four-head mill, the minimum of efficiency in operation, must necessarily require an outlay of \$1,000,000. Then there is a railroad which will have to be built to connect the mine with the mill. This will require considerable outlay. However, there is a certain source of income that may be counted upon. The Seneca already is producing copper. This production will be increased regularly as developments continue. It will not be cheap production, but the company easily may secure the continued use of a custom mill. The Seneca may be able to duplicate the history of the Ahmeek, which paid its way without difficulty just as soon as production commenced.

All three mines of the Copper Range group, Champion, Baltic, and Trimountain, showed a slight increase in the

output of copper for the month of January compared with the production for December. Champion led all the others, producing 49,000 tons. This compares with 46,000 for December. It means too that the production of the premier mine in the Copper Range will be approximately 2,000,000 lb. of refined copper for January, for the Champion ore today is averaging close to 42 lb. per ton. This record for the Champion is fully up to expectations. Baltic produced 15,000 tons for January, and Trimountain 14,500, just about the same as for December.

Production of the Mohawk for January was 46,628 tons, compared with 48,603 for December. Production of the Wolverine for January was 20,622, compared with 21,769 for December. Mohawk's output of copper will likely be in excess of a million pounds, however, as the grade of ore was a little better than the average for December. Michigan's output was 4215, compared with 4551 for December.

Seneca will continue making shipments to the Baltic mill as rapidly as service is secured until the stock-pile is finished. The second shipment was made this week. It contained mostly rock from the stock-pile, but included some material that now is coming from underground. The smelter return on the first shipment was 22.96 lb. per ton. The mineral did not dress quite as well as ordinarily.

The Seneca shaft will reach the fourth level this week. The present depth is 2086 ft. At the fourth level there will be some concrete work to do in the shaft for the permanent haulage-way. No drifting is at present under way at the third level in the vein, although both openings show good faces where the work stopped. This lateral work will be resumed in the near future. The openings in the levels above, now working in ore, continue to send up average ore.

Unwatering the Gratiot shaft is under way. Bailers have been started, and the work will be done as rapidly as possible. It is the intention of the management to start sinking the Gratiot shaft immediately. At a proper depth laterals to connect with the new Seneca shaft will be put down to provide ventilation.

MONTANA

ANACONDA COMPANY NEEDS MINERS.

BUTTE.—The Anaconda company is increasing its working force as fast as experienced miners can be secured. There are plenty of men but a scarcity of good all-round miners. Most of the large mines in operation have the sign 'Men Wanted' hung out upon their gates, which is a rarity in Butte.

A 4-ft. vein of 5.2% copper has been found in the Birtha shaft of the North Butte company. This is on the extreme easterly portion of the company's property, within 100 ft. of the surface, and adjacent to the Bullwhacker mine.

The Davis-Daly in January produced 1,192,900 lb. of copper, an increase of 700,000 lb. over December. The skips were put in operation at the Colorado shaft on February 8 and 9, when operations were suspended for

48 hours in order to make the change from the old cages and build the skip-pocket at the collar of the shaft. The company is shipping 100 tons of silver ore daily from the Hibernia mine in the district west of Butte. This ore is going to the American Smelting & Refining Co.'s smelter at East Helena.

The Touloume is shipping 150 tons daily to the smelter. It is stated that the orebody recently opened on the 1200-ft. level is proving to be of good size and grade.

JEFFERSON COUNTY.—The Butte-Elk Park Extension Mining Co., operating at Elk Park, 12 miles north of Butte, is dewatering the shaft and workings on the 400-ft. level, preparatory to resuming sinking where it was stopped by a shut-down caused by the coal strike. Three veins in the upper levels will be prospected while the pumping is being completed; one on the 250-ft. level will be cut on the north side of the shaft, and two will be cut on the 400-ft. level. These three lodes have never been opened underground. It is planned to sink to the 1400-ft. level and develop the 710 acres that the company owns.

HELENA.—The Legal Tender mine is producing steadily, having shipped two cars of high-grade silver ore already this month. One car assayed 169 oz. and the other 479 ounces.

NEVADA

TONOPAH AND DIVIDE OPERATORS INCREASE WAGES.—THE NEW WAGE-SCALE.

TONOPAH.—Labor trouble in the Tonopah and Divide districts as a result of the removal of the 50-cent wage bonus has been adjusted by the operators giving an increase in wages equal to the amount of the bonus previously paid, the commissary to be continued with the operators making a 5% profit. The agreement, which has been ratified by both parties, extends for one year from February 14. The mines of both districts practically had been inactive since February 8, with the exception of those owned by a few companies which continued to pay the bonus. The miners and craftsmen, principally the former, walked out as individuals and many have left the districts, but not enough have gone to seriously interfere with a resumption of operations and it is thought by the operators that conditions will quickly become normal. The Tonopah and Goldfield railroad, over which practically all of the men left Tonopah, reported an abnormal number of outgoing passengers on only the first two days following the walkout, 100 passengers being carried the first day and 51 the second, indicating that comparatively few men went to other districts. The new scale is as follows: Machine-men, \$6, with \$6.50 for shaft work; timbermen, \$6; timbermen helpers, \$5.50; shovelers and trammers, \$5.50; top-men, \$5.50; hoisting-engineers, \$6.50; boss carpenter, \$7.50; carpenters, \$7; head blacksmiths, \$7; blacksmith helpers, \$5.50; tool-sharpeners, \$6.50; lathe-men, \$7; machinists, \$6.50; machinist helpers, \$5.50; electricians, \$6.50.

LIDA.—Eighteen inches of ore assaying \$145 in silver, lead, and copper has been opened on the foot-wall of the

vein at a depth of 225 ft. in the Allied, in the new district of that name, which was formerly known as the Indian Gardens. The find was made in a drift driven west to cut the downward extension of the ore-shoot. Tests of the ore are being made and it is planned to erect a 50-ton concentrator. There is estimated to be 10,000 tons of material of mill-grade exposed.

DIVIDE.—Ore from the Treasure Divide lease on the Revert is being shipped to the MacNamara mill at Tonopah. The material is being mined at and near the bottom of a 100-ft. shaft in which a 10-in. seam assaying from \$5000 to \$15,000 has been exposed from the 70-ft. point. Machinery for use in sinking the shaft to greater depth has been purchased.

BEOWAWE.—J. K. Turner, a mining engineer of Goldfield, is examining the Cortez mine, 26 miles south of

from the present depth of 30 ft. Lateral work will be done from the winze and the entire surface of the west-dipping shale will be prospected in this vicinity before sinking of the shaft is resumed. Assays of from \$5 to \$7 are being secured. A raise has been started from near the face of the east cross-cut on the 375-ft. level of the Great Bend. The face of the cross-cut is now vertically under the main east-raking ore-shoot on the upper levels and it will be extended to open the western edge of those shoots.

UTAH

STRIKE AT BINGHAM INSTIGATED BY I. W. W.—OPERATIONS AT ALTA AND PARK CITY.

BINGHAM.—On the morning of February 9, all of the mines in this district received letters signed by the



GOLD HILL, IN THE DEEP CREEK DISTRICT, UTAH

here, for Coleman and Reitze, New York brokers who recently took over the Candelaria mines on an option and sold them on a report made by Mr. Turner. It is reported that the brokers have the same object in view in having the Cortez examined. They have secured an option from the Wenban estate. The Cortez owns 48 claims, developed through tunnels reaching a maximum depth of 1500 ft. on the vein, with miles of other workings. According to Mr. Turner, the Cortez produced \$12,000,000 in silver ore during the 'seventies. The mill tailing is being sampled by F. C. Beedle, who successfully re-treated the tailing from the old mill at Belleville. The Cortez is in Lander county.

GOLD MOUNTAIN.—Work in the drift tunnel of the Washington gold-quartz mine has been discontinued because of an unusually hard formation found on both walls of the vein, and another tunnel, now 40 ft. long, is being driven in a cross-vein that was the main objective of the first. This cross-vein has been prospected with shallow shafts and trenches and assays of as high as \$150 in gold, silver, and lead have been secured. The face of the tunnel assays \$10, with a 10-in. seam assaying \$81.50. The main ore-shoot is estimated to be 75 to 100 ft. from the present face.

GOLDFIELD.—An air-power hoist has been erected at the winze being sunk from the 815-ft. level of the Grandma and the winze will be continued to at least 100 ft.

'Grievance Committee' of the Metal Mines Industrial Workers Union No. 88, an auxiliary of the 'I. W. W.', making the following demands on the mining companies:

1. Eight-hour day, collar to collar.
2. Two men on all machines.
3. Minimum wage of \$6 per day for men working underground.
4. No tools to be carried on cages when lowering or hoisting men.
5. Modern change-houses to be installed immediately.
6. No man to work alone.

The mining companies were given 24 hours in which to comply with these demands. No attention was paid to them by any of the companies. For two weeks prior to the date when the letters were received, there had been rumors that members of the I. W. W. were contemplating making demands, but little or no credence was given them. Recently the underground mines in this district have had a total of about 1200 men on the payroll and a similar number were engaged in surface operations at the Utah Copper and other properties. On the morning of February 10, about 500 metal miners, members of the I. W. W., went on strike. The United States mine was forced to suspend operations, while about one-fourth of the day shift of underground men at the Utah Apex reported for work. All of the mill, carpenter, and mechanical forces of the Apex reported for work. At the

Utah Consolidated (Highland Boy) mine, about 10% of the underground men failed to report. The following day the situation was more serious; less than 10% of the miners at the Highland Boy mine reporting, while the Utah Apex had but a small force, sufficient to keep the pumps running. The United States and Utah Metal & Tunnel companies were closed completely. On the afternoon of the 10th, Albert Wills, said to be an alien, born in Wales, and one of the leaders of the I. W. W. in the Western country, was arrested on a Government charge and taken to the county jail in Salt Lake City. None of the employees of the Utah Copper Co. quit work as a result of the strike, and operations at that mine are going along in a normal manner. Twenty-six special deputies, and a number of regular deputies, were sent to Bingham and stationed at the various railroad bridges and tunnels to guard against their being tampered with by strikers. About a half-dozen strikers were arrested the first day of the strike on the charge of intimidating the employees who wished to remain at work. At present machine-men in the mines here receive \$5 per day of 8 hours and muckers \$4.50. Operators state that in view of the present program of curtailment, they cannot afford any increase in wages, as a number of the properties are just about 'breaking even'. Several hundred of the strikers have already left camp. The present strike is the first labor trouble of any importance since the general strike in September 1912, which lasted for nearly three weeks and involved every mine in the camp. On February 12, handbills were distributed calling on employees of the Utah Copper Co. to strike, but these met with no response.

PARK CITY.—Shipments of ore for the week ending February 7 totaled 2382 tons, as compared with 2324 tons for the previous week. Of this amount, Judge Mining & Smelting shipped 802 tons; Silver King Coalition, 542 tons; Ontario, 664 tons; Daly-West, 209 tons; Naildriver, 110 tons; and Daly Mining, 55 tons.

Preparations are being made to take ore from the various workings in the Naildriver mine through the old Queen tunnel. This arrangement will eliminate a half-mile haul over heavy roads, and will permit increased shipments from this property. Ore-bins are being constructed at the portal of the Queen tunnel. At present from 20 to 30 tons per day is being mined. In the south cross-cut from the 600-ft. level, four feet of shipping-ore was recently opened up. This ore apparently lies in a fissure which parallels the one from which considerable ore has been and is being mined. The same orebody has been cut, it is said, in the south cross-cut on the 700-ft. level.

ALTA.—Assays of ore taken from the rich shoot recently opened up in the drift along the 125-ft. level in the Sells mine, adjoining the South Hecla, show high results, according to W. H. Weyher, general manager. An average sample of the face, which is approximately four feet wide, assayed \$13.20 in gold, 157.2 oz. silver, 6.9% lead, and 11.29% copper. With the drifting done along the foot-wall of the vein and with the drilling already done, an orebody 8 ft. long, 10 ft. high, and 8 ft.

wide from the foot-wall of the vein toward the hanging-wall side, has been proved. In a cross-cut, run approximately 15 to 20 ft. back from the face, the fissure is 18 ft. wide.

No shipments are being made from the Cardiff mine at present, but mining is being conducted regularly and the ore stored in the large bins about three miles below the mine and on the main Big Cottonwood highway. Officials of the company report the mine in excellent condition and recent developments have been highly gratifying. As soon as the roads permit, a very large tonnage will be available for immediate shipment.

WISCONSIN

REVIEW OF ZINC AND LEAD MINING DURING JANUARY.

With prices for zinc ore again fairly well established and demand for all grades exceptionally good, operators began the new year with an increased production of ore. All of the large operating groups started new drilling-machines, and virgin ground, held under lease, was explored. Noteworthy strikes were made at several points in the field and by the middle of January the zinc-mining industry of south-west Wisconsin wore a more cheerful aspect than at any time since the close of the War. Premium-grade blende, offered by operators of electromagnetic separating-plants, commanded a base price of \$61 per ton, 60% standard commercial assays, with the top grades bringing as high as \$63 per ton. This base held until well along into the third week when a decided slump in price occurred, the base receding to \$55 per ton for premium blende or first grades of zinc ore, and an even lower figure was quoted for prime Western blende, or second-grade zinc ore. The drop was explained by the fact that two of the leading consumers had encountered fresh labor troubles at smelters, temporarily stopping their purchases. This enabled their weaker competitors to adjust the markets to suit themselves. Another factor is to be found in the lowering of sterling exchange, which reached a point under \$3.50, practically stopping slab-zinc exportations. Slab zinc dropped from 9.5c. per pound to less than 9c., East St. Louis, and with the drop in the price of metal came a corresponding lowering in the level of zinc-ore prices. Some of the ground lost was recovered before the close of January, the base at the end of the month reaching \$57 per ton on first grades and \$55 per ton on second grades.

The rapid shift in prices affected both production and shipments. Low-grade producers, many of whom had discontinued and who had but recently resumed operations under the incentive of advancing prices, were the first to feel the effects of lower markets and recoveries at mills of run-of-mine ore decreased. Shippers of the high-grade refinery-ore observed caution in marketing their product, because they felt that the prices obtained for metal warranted better offerings for zinc ore, and there was a well defined disposition to hold high-grade blende for better prices.

Producers of lead ore enjoyed a good month and prices were steady and high. The base price held almost uni-

formly throughout the month, at \$100 per ton, base 80% metallic content. Buyers engaged in the field were anxious enough to submit bids, but sellers wanted a base of \$110 per ton, and were content to hold finished lead-ore concentrate. Lead ore in reality is becoming scarce and higher prices may be anticipated. Mining companies able to confine operations to lead-ore recovery have done so, and have made some money. The present winter has been one of the severest known to the field in thirty years. Heavy snows and extremely low temperatures have hindered operations everywhere. The coming spring will find small companies seeking lead ore in top runs and shallow surface-diggings, should present prices for lead be maintained.

There were no shipments of iron pyrite during the month of January. Prices have been unsatisfactory for a long time and zinc-ore separating-plants have been piling up the ore recovered and the surplus on hand is now the largest ever known in Platteville and the surrounding districts of the Wisconsin field.

Shippers of carbonate-zinc ore have been marketing conservatively, although the price offerings have been fair. The price for the greater part of the month ranged from \$30 to \$35 per ton, but in the closing days of the month an advance was made to \$38 when the shippers strangely withdrew entirely, possibly in anticipation of still further advances.

Deliveries of both zinc ore and lead ore during January were as here shown:

Districts	Zinc, lb.	Lead, lb.
Benton	11,982,000	464,000
Livingston	6,020,000	.....
Galena	4,492,000	362,000
Hazel Green	1,596,000	.....
Cuba City	1,370,000	312,000
Highland	720,000	.....
Linden	628,000	32,000
Platteville	460,000	160,000
Shullsburg	60,000	.....
Total	27,328,000	1,330,000

Deliveries of high-grade blende from refineries were made to smelters during January as follows:

Company	Blende, lb.
Mineral Point Zinc Co.	4,896,000
National Ore Separators	3,810,000
Wisconsin Zinc Co.	3,792,000
Block-House Mining Co.	460,000
Total	12,958,000

The gross recovery of milled ore for the month amounted to 13,737 tons. Of this the Mineral Point Zinc Co. received 4456 tons; National Ore Separators, 4000 tons; Skinner Roasters, 3471 tons; and the bulk of the remainder was shipped from mines to smelters direct. Of the high-grade the Mineral Point Zinc Co., received 2448 tons; American Zinc Co., 1896 tons; Grasselli Chemical Co., 1346 tons; United Zinc Smelters, 1033 tons; Illinois Zinc Co., 640 tons; Lanyon Zinc Co., 202 tons. The total net deliveries out of the field, for the month, to smelters, amounted to 7904 tons.

BRITISH COLUMBIA

PLANS FOR RECOVERING PLATINUM ON CARIBOO RIVER.

ATLIN.—While British Columbia has been comparatively free from troubles with respect to its placer-mining camps, disputes sometimes arise. One of these has been before the courts for some months. The disputants are Isaac Matthews and L. Schultz, the former being the owner of the Poker placer-gold claim on Spruce creek in the Atlin district and the latter the owner of an adjoining claim known as the Peterboro. Mr. Schultz, in the course of operation, permitted his men to encroach be-



A BIT OF BRITISH COLUMBIA

yond what Mr. Matthews considered his line. In the action that followed Mr. Matthews was upheld, whereupon he followed up his success with a suit for damages to the extent of \$100,000. This latter litigation is about to come to trial and developments are being very closely followed by the placer miners.

BARKERVILLE.—J. M. Yorston reports that development work is proceeding on the Proserpine Mountain properties. Mr. Yorston also states that some excitement was occasioned recently by the discovery of quartz-gold in the creek about three miles from Barkerville. Much is expected both by miners and settlers from the Pacific Great Eastern railway, now being constructed through the Cariboo into the Peace River country. This new railroad will open up a country rich in mineral resources.

The plans of the Cariboo Gold-Platinum Extracting Co., Ltd., are attracting interest. The company's prop-

erty, situated about 20 miles east of Quesnel, consists of five leases on the river and a ranch of some size, the latter having been acquired recently. Machinery now is being transported over the Cariboo road, consisting of a drag-line excavator with a Shearer & Mayer one-yard bucket, a specially designed concentrator with a capacity of from 25 to 150 tons of black sand per day, and a steam plant. G. J. Marsh, president and general manager of the company, states that he has been successful, after twenty-five years of experiment, in the extraction, at a reasonable cost, of gold and platinum from the black sand. In describing his method he asserts that the sand first is crushed to pass a 200-mesh screen and afterward treated by an electro-chemical process. Tests, Mr. Marsh declares, have proved its commercial feasibility. The importance of this to British Columbia is emphasized by the many creeks, rivers, and beaches where deposits of black sand are to be found. In dredging and other placer operations black sand is the source of much trouble on account of its high specific gravity making it impossible to recover gold and platinum at a profit. Mr. Marsh appears to be confident that success is assured for his company. Before operations start about \$250,000 will have been invested, and the capital, it is said, has been raised in Minneapolis. To induce individual miners to produce black-sand concentrate for treatment at the extraction plant Mr. Marsh has a portable concentrator which he proposes distributing by sale or lease, and he hopes to see the bars of the Fraser and other rivers exploited.

KASLO.—The Utica mine, on Paddy's peak, is attracting much attention in this district. A portion of the mine workings was leased to A. J. Poyntz, formerly superintendent of the property, and shortly afterward he made a strike of such richness that the returns approximated \$100,000. His lease is to expire in the course of two months and it is expected that C. F. Caldwell, one of those interested, will take steps to interest capital in the further development of the property. The ore taken out by Mr. Poyntz was rich in silver.

ONTARIO

COBALT.—DECISION REGARDING ASSESSMENT WORK.

COBALT.—The silver mines of Cobalt are benefiting from the high rate of exchange between the United States and Canada. On the date of writing, with silver quoted at \$1.34½ per ounce in New York, and with American funds at a premium of 18c., the Canadian producers are receiving \$1.59 per ounce for their silver.

At the leading mines, including the Nipissing, Kerr Lake, and Coniagas, the cost of producing silver averages about 43c. per ounce. The camp as a whole produces its silver at an estimated cost of 58c. per ounce, the cost at some of the smaller mines being more than 80 cents.

The Mining Corporation of Canada has decided to carry on a limited amount of exploration work in Butt township, in the district of Nipissing, the work to be started in the early spring. Late last summer the discovery of radium-bearing ore attracted attention to that district, which is likely to be the scene of extensive pros-

pecting operations during the coming summer season.

On February 2 the Coniagas company paid \$100,000 in cash for the Trethewey-Cobalt mine. The Coniagas also has an option on the Gamble-Thompson claims in the Gowganda district.

The system of representation of employees is working satisfactorily at Cobalt. One of the first moves has been the adoption of a 'Sick Benefit Fund' by the Dominion Reduction company. The plan is regarded with favor throughout the town and is expected to be adopted by other companies.

The Kerr Lake has commenced the year with production at the rate of 1,250,000 oz. per year. Costs for the past fiscal year were 40.81c. per ounce. Allowing for increased costs to around 45c. on account of the high bonus paid to the employees, it is still possible that net profits may this year approximate \$1. On the indicated production this would amount to \$2 per share on the company's 600,000 issued shares.

TORONTO.—A decision of considerable importance to mining men has been rendered by the Mining Commissioner in relation to the ownership of a claim in Bernhardt township in the Kirkland Lake district. The claim was originally held by Robert Ferguson, but was restaked on behalf of A. Koury on the ground that Ferguson had not performed the requisite assessment work. It was proved that Ferguson had hired men to do the work, paying them upward of \$200, and that they had made a sworn statement as to having done so. But the Commissioner decided against him and awarded the claim to Koury. The decision has caused much adverse comment as likely, if sustained, to work much hardship to claimholders who are dependent on men employed to do their assessment work in their absence, and the fear is expressed that it may deter outsiders from investing in undeveloped prospects.

The influx of American capital into the mining districts of Northern Ontario is being increased by the present high rate of United States exchange. With American money at its present premium in Canada, the purchaser saves about \$18,000 on every \$100,000 in comparison with the Canadian buyer, and in addition secures the premium in marketing the output in the United States. There is every prospect that investments in the newer gold and silver camps will show an increase.

A large number of Canadian silver-mining companies are desirous of resuming the trade in cobalt-oxide with Germany, which had assumed considerable proportions before the War. The depreciation of the German mark presents an obstacle, and inquiries which have been made as to whether business could be done under a system of government credits, point to the conclusion that this is hardly feasible as public opinion would be strongly against it. The suggestion has been made that the trade should be carried on by barter, the companies exchanging cobalt-oxide for pottery, in the manufacture of which cobalt-oxide is extensively used. M. J. O'Brien, a prominent Cobalt mine owner, is expected to visit England shortly in connection with the matter.



CALIFORNIA

The following awards have been made by the War Minerals Relief Commission to California claimants who operated chrome-properties during the War:

G. F. Finster, Patterson, \$3246; Mortimer Savage, Forest Hill, \$4905; Samuel H. Dolbear, San Francisco, property in Siskiyou county, \$10,955; J. S. Shields, East Auburn, \$317; John Anderson, Altaville, \$708; C. E. Shaffer and Frank Atherton, Jamestown, \$470; Geo. E. Brown, Roseville, \$223; Herman Costello, Nevada City, \$157; R. H. Lake, Yreka, \$516; N. E. and E. E. Hayes, Fort Jones, \$198; I. B. Sovy, Etna Mills, \$167; Chastain Brothers, Gazelle, \$1034; N. Lambert, Fort Jones, \$385; W. C. Green, Georgetown, \$555; D. F. Wiley, Folsom, \$605.

Reports reaching the Western mining districts that the Minerals Relief Commission is considering payment of claims filed by claimants who operated without formal requests from the Government are erroneous. The Commission has no such power, as the law under which present awards are made specifically states that only those claims may be considered where a formal request can be shown.

The Committee on Mines of the two houses of Congress is, however, considering amendments to the present law which would permit compensating those who operated in good faith, accepting as sufficient notice the appeal made by the Government through newspapers and placards.

Auburn.—Work has been resumed at the Voss mine, in the Pilot Hill district, and the erection of a 40-stamp mill is proceeding. This property was formerly a noted gold producer and is said to contain large reserves of profitable ore. San Francisco and Idaho people are chiefly interested.

Grass Valley.—The Alcalde company has completed repairs to its shaft and resumed development on a lower level. The mill will start before the end of March.—The Empire Mines Co. has practically completed the electric railway from the Pennsylvania mine to the Empire mill. The installation of 20 stamps in the Empire mill has been completed, bringing the total to 60. Classifying equipment for the new battery is being placed in position.

Ingot.—The Afterthought Copper Co. has purchased from Chester Lowman the Donkey copper property. The Donkey has been developed sufficiently to establish the existence of good ore. It was worked for several years by the late Alexander J. Cook, who was the original locator.

Nevada City.—Preparations have been made for the resumption of work at the Delhi group, near Columbia hill, under the management of Harry B. Skewes. The long cross-cut from the shaft is to be extended to the vein. The property is under bond to A. A. Codd of Reno.

IDAHO

Coeur d'Alene.—The Caledonia Mining Co. had a surplus of \$570,520 on December 31 last, according to the annual report, just issued from its office at Kellogg. This is nearly 22c. per share on the issue of 2,605,000 shares. The statement of production and operating cost shows the production of 15,225 tons of ore in 1919. This ore yielded 4,224,053 lb. of lead worth \$231,210; 507,862 oz. of silver worth \$548,824; and 56,000 lb. of copper worth \$5179, a total of

\$785,213. The net value of the bullion was \$558,421 after a deduction of \$226,791 for smelter charges. The average content of the ore was nearly 14% lead and over 33 oz. of silver to the ton, according to assays.

George Decker, president of the New Caledonia Mining Co., which is the outgrowth of the consolidation of the Bernice and Wardner companies of the Kellogg district, has been in Spokane to purchase new machinery.—Ore has been followed for 100 ft. in a drift run on the 750-ft. level in the property of the Ajax Mining Co., according to report from A. C. Bixby, manager. The drift is proceeding with two shifts and at the rate of eight feet per day.

Four hundred miners in the employ of the Federal Mining & Smelting Co. at its Morning mine here averaged nearly \$8 per day in wages for January, according to the records of the company.

The men are employed under a contract system whereby they receive a fixed price per ton for all ore mined and delivered to the mill. They furnish the labor only, everything else incident to the extraction of the ore being supplied by the company. No limit is placed by the company on the tonnage that may be produced.

Besides miners, the contract system includes the shift-bosses, motormen, cagers, pipemen and timbermen, who receive a bonus of 50c. per day on top of their contract wages. The average wages received for the second half of January follow: motormen, cagers, pipemen, \$7.93; men on 1400-ft. level, \$7.86; men on 1800-ft. level, \$7.94; and men on 2000-ft. level, \$7.83.

Lemhi County.—Development of the property of the Sunset Mining Co. has reached the point where full tonnage at the mill can be maintained, according to G. W. Wood, manager for the company. The mill is of 50-ton capacity and is being operated 24 hours per day.

NEVADA

Mina.—The shaft of the Fagan-Consolidated is now down 71 ft. and the lessees' shaft has been sunk to a depth of 36 ft. The vein in the south-west drift of the Fagan-Consolidated has widened and some galena has been found.

Pioche.—Ore-shipments were increased last week to a total of 2800 tons as compared with 1950 tons the week before. The increase was due to the shipments from the Prince Consolidated mine which doubled its output, shipping 1700 tons of ore last week.

The shipments were as follows:

Prince Consolidated, 1700 tons; Virginia Louise, 650; Black Metals, 150; Combined Metals, 100; Consolidated Nevada-Utah, 100; Pioche assay office, 100; total, 2800 tons.

OKLAHOMA

Miami.—A committee of the Chamber of Commerce of Miami will officially present the State with a deed to 40 acres of land near the city as a site for a State School of Mines. This will complete the matter so far as the question of placing the school at Miami is concerned, as the State has agreed to proceed at once with the construction as soon as the deed is in its possession. Plans for the buildings are under way. The legislature appropriated \$200,000 for buildings, and the appropriation will be increased as requirements demand.

STATEMENT BY MR. HOOVER

On February 14 Herbert Hoover made public the following letter to his friend, Casper W. Hodgson, of Yonkers, New York:

I have noted your feeling that I should answer some of the solemn discourses on my private life and crimes. I do seem to get into the way of politically-minded folks even when trying to keep out of politics.

Some things that have been said of me cause me a sense of financial oversight. For instance, I have made careful inquiries and I regret that so far I cannot find:

(A) The \$10,000,000 I am said to have made in my early youth or even middle age, or altogether, or any respectable part of it.

(B) The investments I am supposed to have in Great Britain.

Like the negro porter who was asked to change \$10, I am grateful for the compliment. I am sorry that these sums do not exist, for they would be useful for the Children's Relief.

I have also given deep consideration to the other items mentioned:

(A) Am I a British subject? Did I ever apply for such citizenship? No. Many generations of persecuted Quaker ancestors would rise in their grave at such a discovery. They should remain quieted, however, for no Californian could live three months in a London climate and become a British citizen if he knew it. One thing that reassures me that this did not happen without my knowledge is that the British refused to allow me to come into their island during the War without an American passport. Also, I feel that my accent was disinfected of any English, French, Chinese, Russian, or other taints, by my presence in the United States a portion of every calendar year of my life—except three—even including the five in which that United States exercised its right to draft my services, a good portion abroad.

(B) Did I ever rent a 'residence' abroad? I plead guilty of this crime, but in mitigation I do appeal to the feelings of fathers who object to hotel life for babies and children.

(C) What about that political lunch where I was supposed to have entered upon a dreadful conspiracy against the wealth of the American people? My real distress in this matter is not to prove an alibi or even to complain that my name was not even mentioned, as the guests assert, but it is that I was not even invited and therefore lost an excellent lunch.

(D) I plead guilty to the criminal charge of pursuing my engineering profession in foreign parts again and again. I have a fervent hope that this new doctrine of criminality will not deter our citizens from extending American professions and business anywhere in the world. They always bring something home, and pay taxes on it.

(E) I gather also that it is moral turpitude on my part to have managed large enterprises. The hope to rise from the ranks of labor to the ranks of management will, however, probably not be crushed from the hearts of the American boy even by this onslaught.

Announcement that there will be no general extension of time for the filing of income-tax returns has been made by the Bureau of Internal Revenue. Complete returns, accompanied by at least one-fourth of the amount of tax due, must be in the hands of collectors on or before March 15, 1920. The only extensions to be granted, it is announced, are those in specific cases where urgent need for additional time in preparing the return is conclusively shown. To avoid penalty every person whose income for the calendar year equaled or exceeded \$1000 or \$2000, according to their marital status or their status as the head of a family, must file a return. The law makes no exceptions, the penalty for failure being a fine of not more than \$1000.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

E. P. Earle is at Pasadena.

L. D. Ricketts is at Chandler, Arizona.

Newton B. Knox has returned to London from Spain.

E. A. Weinberg, formerly in Queensland, Australia, is now in New York.

J. D. Millen has resigned as manager of the Mount Bischoff tin mine, Tasmania.

F. V. Bodfish, manager for the Alta Tunnel & Transportation Co., at Alta, Utah, is in New York.

H. L. Sulman has been awarded the gold medal of the Institution of Mining & Metallurgy, London.

E. P. Mathewson did not come to San Francisco, but proceeded direct from Vancouver to New York.

C. H. Macnutt is now manager for the Black Lake Asbestos & Chrome Co. at Black Lake, in Quebec.

L. S. Cates has returned to Salt Lake City after a trip to the Ray Consolidated properties in Arizona.

Morton Webber was here during the week; he has gone to Pasadena, on his way back to Salt Lake City.

C. M. Eye has gone to Humboldt and Hayden, in Arizona, and expects to come to San Francisco on his return.

Carl J. Trauerman, mining engineer of Butte, Montana, is in New York, and can be reached at A. I. M. E. headquarters.

W. H. Goodchild has been awarded the Consolidated Gold Fields gold medal by the Institution of Mining & Metallurgy, London.

Ben. B. Thayer, vice-president of the Anaconda Copper Mining Co., has gone to South America to inspect the Andes copper mines, in Chile.

G. L. Johnson, connected with the Chile Copper Co. at Chuquicamata, Chile, was in Utah recently, visiting mining and metallurgical plants.

Cecil H. Desch has been appointed Professor of Metallurgy in the University of Sheffield in succession of J. Oliver Arnold, who resigned recently.

George R. Allen, president of the Chosen Minerals Co., who arrived on 'Shinyo Maru', has gone to New York. He expects to return to Korea early in May.

Roy B. Earling has resigned his position as superintendent of the Metcalf division of the Arizona Copper Co. to accept a position with the U. S. S. R. & M. Co. at 55 Congress street, Boston.

D. C. Jackling received the Distinguished Service Medal at the hands of General Liggett at the Presidio on February 10. The medal was bestowed for his valuable services as organizer of Government explosive plants.

Donald Fraser, who, with his brother, William Fraser, organized the Pahang Corporation, one of the first organizations to exploit the tin deposits of the Malay peninsula, is visiting mining properties in Utah and Idaho. He is associated now with W. E. Reuss in the development of the Elmore Copper Co., which has large holdings near Mountain Home, Idaho.

David Swickheimer died at Denver, Colorado, on February 5. He was born in Ohio and was 67 years of age. He located and opened up the Enterprise mine, on Newman hill, at Rico, Colorado, and made a fortune by selling it to Crawford & Posey, who formed the Enterprise Mining Co. He had a reputation for honesty and integrity in all his dealings.

THE METAL MARKET



METAL PRICES

San Francisco, February 17

Aluminum dust, cents per pound.....	65
Antimony, cents per pound.....	12 00
Copper, electrolytic cents per pound.....	10 00
Lead pig, cents per pound.....	9 00-10 00
Platinum, pure, per ounce.....	\$155
Platinum, 10% iridium per ounce.....	\$180
Quicksilver, per flask of 75 lb.....	\$80
Spelter, cents per pound.....	10 00
Zinc dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

February 18.—Copper is dull but steady. Lead is quiet and strong. Zinc is inactive and firmer.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Feb. 10.....	133.50	88.75	Jan. 6.....	130.80	78.19
" 11.....	134.00	89.50	" 13.....	133.71	79.49
" 12 Holiday.....			" 20.....	132.04	78.81
" 13.....	132.00	84.75	" 26.....	132.58	80.00
" 14.....	131.00	82.00	Feb. 2.....	134.37	83.83
" 15 Sunday.....			" 9.....	132.50	87.69
" 16.....	130.00	83.12	" 16.....	132.10	85.72
Monthly averages					
Jan.	1918 88.72	1919 101.12	1920 132.77	1918 99.82	1919 106.36
Feb.	85.79	101.12		Aug.	100.31 111.35
Mch.	88.11	101.12		Sept.	101.12 113.92
Apr.	95.35	101.12		Oct.	101.12 119.10
May	99.50	107.23		Nov.	101.12 127.57
June	99.50	110.50		Dec.	101.12 131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending	Cents
Feb. 10.....	Jan. 6.....	19.25
" 11.....	" 13.....	19.50
" 12 Holiday.....	" 20.....	19.16
" 13.....	" 26.....	19.08
" 14.....	Feb. 2.....	19.23
" 15 Sunday.....	" 9.....	19.12
" 16.....	" 16.....	19.10
Monthly averages		
Jan.	1918 23.50	1919 20.43 1920 19.23
Feb.	23.50	17.34 22.51
Mch.	23.50	15.05 22.10
Apr.	23.50	15.23 21.06
May	23.50	15.91 20.45
June	23.50	17.53 18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents
Feb. 10.....	Jan. 6.....	8.05
" 11.....	" 13.....	8.73
" 12 Holiday.....	" 20.....	8.75
" 13.....	" 26.....	8.75
" 14.....	Feb. 2.....	8.75
" 15 Sunday.....	" 9.....	8.75
" 16.....	" 16.....	8.75
Monthly averages		
Jan.	1918 6.85	1919 5.60 1920 8.63
Feb.	7.07	5.13 8.63
Mch.	7.26	5.24 8.63
Apr.	6.99	5.05 8.63
May	6.88	5.04 8.63
June	7.59	5.32 8.63

TIN

Prices in New York, in cents per pound:

Date	Average week ending	Cents
Jan.	1918 85.13	1919 71.50 1920 62.74
Feb.	85.00	72.44 62.74
Mch.	85.00	72.50 62.74
Apr.	88.53	72.50 62.74
May	100.01	72.50 62.74
June	91.00	71.83 62.74

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending	Cents
Feb. 10.....	Jan. 6.....	9.42
" 11.....	" 13.....	9.75
" 12 Holiday.....	" 20.....	9.50
" 13.....	" 26.....	9.54
" 14.....	Feb. 2.....	9.41
" 15 Sunday.....	" 9.....	9.07
" 16.....	" 16.....	9.06
Monthly averages		
Jan.	1918 7.78	1919 7.44 1920 9.58
Feb.	7.97	6.71 9.58
Mch.	7.87	6.53 9.58
Apr.	7.04	6.49 9.58
May	7.92	6.43 9.58
June	7.92	6.91 9.58

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Average week ending	Dollars
Jan. 20.....	Feb. 3.....	85.00
" 27.....	" 10.....	80.00
" 27.....	" 17.....	80.00
Monthly averages		
Jan.	1918 128.08	1919 103.75 1920 89.00
Feb.	118.00	90.00 89.00
Mch.	112.00	72.80 89.00
Apr.	115.00	73.12 89.00
May	110.00	84.80 89.00
June	112.00	94.40 89.00

MONEY AND EXCHANGE

"American iron and steel mills will not even be slowed down on account of foreign exchange—at least not for any length of time, and then only in event of developments highly improbable—so long as there are cars and locomotives to haul raw materials and finished products," says a leading independent manufacturer. "It is the railroad situation, not foreign exchange, that is the neck of the bottle for the steel industry. The railroad situation, owing to the constantly decreasing supply of equipment and locomotive power, is serious at present, but likely to be corrected to an extent in the near future with the impending return of the properties to private owners."

"The public seems to forget that on an average only 10% of American iron and steel products are exported. The past year the proportion may have been a little larger owing to the fact that price-regulation talk had a depressing effect on domestic buying for a considerable period and foreign consumers took advantage of that situation to supply pressing needs. That exports of iron and steel were heavier than usual in 1919 merely accentuates the fact that to such extent home demands had to suffer, as there is the same unsatisfied steel need here as in most foreign countries which have been buying more than ordinarily."

"It would be useless to say that were foreign exchange to remain in its present precarious state indefinitely, thereby affecting adversely our other foreign trade, the steel industry could escape even though only indirectly affected. There is no probability, however, that exchange will permanently remain so low. It is simply another case of the 'darkest hour just before the dawn'. Corrective measures will be applied. Europe is slowly awakening to the fact that she will have to go to work or give collateral for what she gets from this country. Natural wealth of ever the war-stricken countries, such as their farms, forests, and mines, is still unimpaired. They only need application of man-power to renew the golden stream that will mean prosperity to them and, in added measure, to the whole world. Europe has been awaiting payment of indemnities and the help of America before she has tried to help herself. In a measure the affected people are awakened from some of their delusions. As this occurs, the beginning of the end of the trouble now being experienced here and abroad will in all probability commence at once."

Steel manufacturers generally point to the fact that there are no surplus supplies of steel at mills—further than the output which has been temporarily dammed back by inadequate rail facilities—in jobbers', retailers', or consumers' hands. Deferred requirements are vast. In the case of the railroads months ago it was estimated to amount in the aggregate to approximately 10,000,000 tons.

Interruption to output would only make the situation so much more acute, stimulating the soaring prices that pressure of demand is occasioning. A year ago the Railroad Administration refused to buy needed steel even though manufacturers made price concessions. The result is that the country is being treated to the spectacle of a revival of war-commandeering powers to get a small fraction of the steel tonnage needed for railroads for current replacement and upkeep.

Foreign quotations on February 17 are as follows:

Sterling, dollars:	Cable	3.36%
	Demand	3.35%
Francs, cents:	Cable	7.03
	Demand	7.01
Lire, Cents:	Demand	5.49
Marks, cents:	Demand	1.10

Eastern Metal Market

New York, February 11.

Buying of most of the metals has been light and prices of some have declined. The value of foreign exchange which fell to record low levels is a predominating influence in prices and in buying.

Copper demand is light and prices have eased slightly.

Tin has declined several cents because of the erratic change in the pound sterling.

The lead market is the strongest of all but demand is not heavy. Prices are unchanged.

Values of zinc have eased off because of the foreign-exchange situation and because of light demand here.

Antimony is fairly active and higher.

IRON AND STEEL

Because of increased obstacles to production during the last week, including besides shortage of cars, railroad embargoes, and a threatened railroad strike, steel output is not more than 80% of capacity. Insistent buying of both pig-iron and steel augments the upward tendency in prices which are now almost anything. In finished steel, business is being done at \$5, \$10, and over \$25 per ton above the March 21, 1919, schedule, so much talked about, and to which the Steel Corporation still adheres. The independent steel makers, following their practice of committing themselves not much over three months, have been taking business at about their current capacity, while the United States Steel Corporation's statement of unfilled tonnage for January indicates a booking rate fully 50% above capacity, with orders now in sufficient volume to carry to December. Following two weeks of heavy buying in the East, pig-iron transactions have been less active.

COPPER

Demand has fallen off and prices have eased slightly. Under present conditions it is natural that consumers should be backward about committing themselves, and in addition to this it must be recognized that most of the heavy buyers are well covered for at least the fourth quarter. Most large producers are quoting electrolytic at 19c. and Lake copper at 19.25c., New York, for early delivery, with second quarter 1c. above these figures. With the present condition of foreign exchange any export business seems out of the question and is not being considered. There is an outside market in which it is stated electrolytic copper can be bought in lots of carloads up to about 500 tons, at around 18.75c., New York, but the quantity is not believed to be heavy.

TIN

The remarkably low levels to which the British pound sterling fell in the last week of course dragged down with it prices of tin for both spot and future shipment. On February 4, the day of lowest values, spot Straits sold as low as 56.75c., New York, and it is estimated that about 500 tons was disposed of. Buying in general has been very light. Yesterday spot Straits was quoted at 58.25c., New York, values having stiffened each day since the low level on February 4. In future shipment very little business is possible owing to the difficulty in gauging future value of the pound. On Monday, February 9, some light business was done at around 59c. early in the day for February-March shipment, with as high as 59.75c. asked late the same day. The London market has advanced again, spot Straits being quoted yesterday at £395 10s. against £386 5s. per ton a week ago. Arrivals thus far this month have been 650 tons, of which 150 tons has come in at Pacific ports. The quantity of tin afloat is returned as 7150 tons.

LEAD

This market is probably the strongest of any of the major non-ferrous metals. On Saturday, February 7, the American Smelting & Refining Co. advanced its price 1c. per lb. to 8.75c., New York, or 8.50c., St. Louis, bringing it on a par with the outside market which has ruled at this level in New York for some time. Demand is fair and prices are regarded as strong. Spot lead is regarded by some as unobtainable at less than 9c., New York, being scarce in this locality. While production has improved it has not been as fast as was hoped for and, in the view of some, consumption is heavier than the rate of output.

ZINC

This market has been somewhat like that of tin because of the exchange situation which has been a big factor in zinc for some weeks. Values have fallen sympathetically with those of the pound sterling but not as drastically as in tin. Foreign business is of course not feasible but inquiry from galvanizers in this country has been decidedly better in the last day or so. This has tended to stiffen values a little and this tendency has been aided by foreign exchange. Prime Western for early or first-quarter delivery, after falling to around 8.55c., St. Louis, or 8.90c., New York, is now quoted at about 8.65c., St. Louis, or 9c., New York. For second quarter values seem to be about 8.50c., St. Louis, or 8.85c., New York, though some producers will not sell at less than 8.65 to 8.70c., St. Louis, for that position.

ANTIMONY

Demand is very good and the market is strong. Wholesale lots for early delivery are quoted at 11.50c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, is unchanged in a quiet nominal market at 31.50c. and 32.50c., New York, in wholesale lots for early delivery.

ORES

Tungsten: The market is lifeless and marking time pending some tariff decision. Quotations are nominal at about \$6.50 per unit for Chinese ore, \$10 for Bolivian, and \$15 for American high-grade. Ferro-tungsten is nominal at around \$1 per lb. of contained tungsten.

Molybdenum: Quotations are nominal at 75c. per lb. of MoS₂ in regular concentrates. A number of actual transactions can be reported for the first time after a long interval of virtually no trading.

Manganese: High-grade Indian and Chilean ores are offered at \$1 per unit against 80c. realized about two weeks ago and 50c. two months ago. Imports in December are returned as 36,376 tons, bringing the 1919 total to 333,344 tons which compares with 491,308 tons for 1918.

Manganese-Iron Alloys: The ferro-manganese market is strong but not particularly active. Domestic producers are quoting second half at \$160, delivered, and outside of a few lots of spot alloy, very little seems available for first half. Spot delivery has sold at \$175, delivered, this week. About the only British alloy available is for second half for which \$152 to \$155 is asked and also offered. Spiegeleisen is strong at \$55 to \$57.50, furnace. Production of ferro-manganese in January was 18,062 gross tons against 11,210 tons in December, according to blast-furnace reports of 'The Iron Age'. The spiegeleisen output was 5895 tons in January as compared with a production of 4528 tons in December.

Company Reports

SUPERIOR & BOSTON COPPER CO.

Report for the year ending September 30, 1919.

Property: mines in the Globe district, Gila county, Arizona.

Operating Official: E. G. Deane, manager.

Financial Statement: revenue for the year was \$24,327; expense \$39,190; deficit \$14,862.

Dividends: none to date.

Development: 4589 ft. of development work was done during the year largely directed toward determining ore-bodies in the Great Eastern and Old Dominion veins.

Production: 773 tons of 3.86% copper ore was shipped on company account and lessees shipped ore returning royalties amounting to \$4366.

CONIAGAS MINES, LTD.

Report for the year ending October 31, 1919.

Property: mine, stamp-mill, and cyanide plant at Cobalt, Ontario, and smelter at Thorold, Ontario.

Operating Officials: R. W. Leonard, general manager; F. D. Reid, manager; E. H. Clemens, mine superintendent.

Financial Statement: sales of ore and smelter products totaled \$3,574,456. Operating profit, \$645,352.

Dividends: four dividends, No. 43, 44, 45, and 46 totaled \$400,000, making total to date \$9,640,000.

Development: a large quantity of low-grade milling-ore with occasional 'patches' of high-grade has been opened up during the year; 1634 ft. of development work was done.

Operations: mill operated continuously treating 71,743 tons of ore averaging 3.38 tons per stamp; 322 tons of high-grade concentrate averaging 2067 oz. of silver per ton was shipped.

CHILE COPPER COMPANY

Report for quarter ending September 30, 1919.

Property: owns the stock of the Chile Exploration Co., which owns copper mines and reduction plants at Chuquicamata, Chile.

Operating Officials: H. C. Bellinger, general manager; E. E. Barker, mine superintendent.

Financial Statement: net profit on copper delivered, \$773,945, as compared with \$214,139 for second quarter. Profit after paying bond interest, \$45,114, as compared with loss of \$513,597 for second quarter.

Dividends: none.

Operations: 828,914 tons mined and leached, averaging 1.69% copper.

Production: 23,583,722 lb. copper was marketed with an average realization of 18.866c. per pound.

NEVADA CONSOLIDATED COPPER COMPANY

Report for quarter ending September 30, 1919.

Property: mines at Ruth, Nevada; mill and concentrator at McGill, Nevada; the Steptoe smelter. The company also owns controlling interest in the Nevada Northern railway.

Operating Officials: C. B. Lakenan, general manager; Robert Marsh, Jr., mine superintendent; George C. Riser, mill superintendent; R. E. H. Pomeroy, smelter superintendent.

Financial Statement: operating profit for the quarter, amounting to \$331,153, reduced the accumulated losses for the year to \$394,986. Profits did not equal dividend disbursements, however, so that there is a net deficit of \$1,711,321 for the first nine months of 1919.

Dividends: dividend in third quarter of 1919, \$749,796. Total to date \$44,519,225.

Production: 454,255 tons averaging 1.54% copper were

treated; 73% was from the open pit, 27% from Ruth underground workings. Cost per pound of copper was 21.68c. as compared with 16.85c. and 18.07c. for first and second quarters. A strike during most of August reduced the tonnage and increased costs coincidentally. Wages were advanced in July. Copper produced, 9,336,000 lb. for quarter.

RAY CONSOLIDATED COPPER COMPANY

Report for quarter ending September 30, 1919.

Property: mine, railway, and mill at Ray and Hayden, Arizona.

Operating Officials: W. S. Boyd, general manager; C. A. Smith, superintendent of mines; D. D. Moffatt, superintendent of mills.

Financial Statement: net operating profit, \$706,070; miscellaneous income, \$226,076; total income, \$932,147; dividend disbursements, \$788,589; net surplus for quarter, \$143,557.

Dividends: third quarter 1919, \$788,589; total to date, \$23,046,850.

Development: underground development consisted of 2606 ft. or a total to date of 694,671 feet.

Operations: copper produced amounted to 11,534,747 lb. in concentrates, and 136,222 lb. in raw ore shipped to smelter. Ore milled, 392,800 tons averaging 1.828% copper. This is 50% of the normal output before curtailment following the War. Mill extraction, 80.33%. Milling cost, \$1.33; net mining cost, \$1.76; net cost of copper, 15.53 cents.

CHIEF CONSOLIDATED MINING CO.

Report for year ending December 31, 1919.

Property: patented mining claims in the Tintic and North Tintic mining districts near Eureka, Utah. Also control of sundry other properties in same district.

Operating Officials: Walter Fitch, Sr., general manager; Cecil Fitch, superintendent; J. Fred Johnson, assistant superintendent.

Financial Statement: balance sheet shows accounts receivable, \$215,920; Liberty Bond investments, \$551,876; cash on deposit, \$325,674. Net returns from smelter during 1919 were \$2,343,926 and net after deducting charges \$664,720.

Dividends: during 1919, \$282,954 was distributed. Total to date, \$1,517,825.

Development: development footage totaled 25,937 ft. Work was done on both of the present ore-zones and the existence of a third zone below the 1900-ft. level is indicated. Water increased below the 1800-ft. level.

Production: 63,726 tons of ore was shipped of an average gross value of \$55.75 per ton. Silver-lead ore averaged 0.0589 oz. gold; 43.277 oz. silver; and 11.92% lead. 36,558 tons of 'dry' ore is included.

BUFFALO MINES, LIMITED

Report for fiscal year ending April 30, 1919.

Property: the Buffalo mine, Cobalt, Ontario.

Operating Officials: Tom R. Jones, superintendent.

Financial Statement: net income from sale of bullion and ore, \$658,491; miscellaneous earnings, \$16,187; total, \$674,678. Operating expense, \$409,503. Total expenses, \$503,439. Net profit, \$171,238. Balance sheet shows \$617,613 in quick assets including United States bonds.

Dividends: none since 1915. Total to date, \$1,360,000.

Development: 1015 ft. of development work brings total to 24,525 ft.; 20,000 tons of ore are available for milling purposes.

Production: mill treated 28,572 tons from mines, 2000 tons from surface stock pile, and 77,239 tons of old tailing. Bullion returns amounted to 625,786 oz. silver.

Book Reviews

The Iron Hunter. By Chase S. Osborn. Pp. 316, ill. The Macmillan Co., New York. For sale by 'Mining and Scientific Press'. Price, \$2.

This is an autobiography by a man who has had a most interesting career, and writes about it in a breezy style that conveys much of this interest to his reader. From his birth in a log-house in Indiana, through his boyhood struggles and vicissitudes, through his young manhood as a newspaperman in the early mining days of the iron districts of Wisconsin, Michigan, and Ontario, up to his entry into politics, including one stormy term as governor of Michigan, the book is full of interesting incidents in a career more than usually combative. The author says that one of the things that he learned early in life was that one should be as good an anvil as a hammer, be able to take blows as well as give them. This sound and courageous philosophy pervades the book; among all the struggles, physical and mental, that are described, there is not one that was not cleanly fought and frankly described to its conclusion, whether victory or defeat. The book obtains its title from the fact that Mr. Osborn has been all his life stimulated by the romance of iron ore; he has spent a large part of his time prospecting for iron in Ontario, and, during the winter, when prospecting in that northern country is impossible, he traveled and tramped through many foreign countries, studying iron districts and smelters. As evidence of the good purpose to which he thus directed his energies, the discovery of the Moose Mountain iron range stands to his credit. Those who are interested in iron mining will find in this book much general information concerning the industry all over the world, most of the facts given being based on the trained observation of an enthusiast. The districts of Wisconsin, Minnesota, Michigan, Ontario, Lapland, China, and Madagascar, are described with sympathetic insight, accompanied by notes on the use of iron by ancient peoples. The book, however, is not a treatise on iron ore, but is the reflection of a rugged and vigorous personality in all its manifestations, of which the search for iron ore was one of the more absorbing. Nevertheless, we do not believe that the reader will be disappointed where the subject of iron ore is dropped, for the adventurous and exceptional career of the author contains little that is not interesting, particularly when his growing prominence made him an active figure in politics. Mr. Osborn's comments on his contemporaries, many of them eminent nationally, are illuminating, and from an angle that is not often obtained. Perhaps the most interesting of these comments, in the light of recent events, is that referring to the consideration of Woodrow Wilson as a candidate for the presidency of the University of Michigan at the time of the death of President Angell.

In such a book, which is of interest to the engineer as well as to the general reader, we would have liked a few maps, to give a clearer concept of the regions discussed, together with more illustrations. Mr. Osborn's wanderings have taken him to most corners of the globe, from trails through the trackless 'bush' of Ontario to the ruins of prehistoric iron furnaces in the Malay Archipelago, and a set of carefully selected illustrations would have added much to the book. Likewise in places we have found the arrangement difficult to follow; the chronological order is abandoned frequently without apparent reason, resulting in some confusion as to what part of his career the author is discussing. Much of the book gives the impression of having been dictated by a busy man to his stenographer, and then hastily combined with other parts that were written in more leisurely fashion. The result is a lack of coherence that could have been obviated by a little careful revision; yet the reason back of this defect is also the reason for the book's greatest

charm: its simple and candid style, with all the appearance of unsophistication, has subdued the ego of the author in a manner seldom found in an autobiography. Mr. Osborn writes about himself, his victories and his defeats, with the same impersonal directness that he applies, for instance, to his description of the Mesabi range. We are frank to say that we enjoyed reading this book immensely, and we can recommend it heartily to anybody who likes a straightforward statement of the adventurous career of a clean sportsman and a good fighter. L. A. P.

Mechanical Drawing. By John S. Reid. Pp. 226, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.

The author of this book is assistant professor of mechanical drawing at the Armour Institute of Technology, and the book appears to be based on the course given at that institution. It is a good textbook on the subject. An idea of the scope can be gathered from the chapter-headings, which are: Instruments and Their Uses; Drafting-Room Conventions; Freehand Lettering and Geometric Drawing; Orthographic Projection; Representation of Points, Lines, and Planes, Orthographic Projection Applied; Isometric Projection; and Working Drawings. In an appendix, additional matter is included on lettering and geometrical drawing, and shades and shadows and conic sections are also discussed. Another appendix contains what is perhaps the most distinctive feature of the entire book, namely, a summary of the answers to a questionnaire addressed to 200 leading drafting-offices and including 35 questions covering standards of practice from the kinds of dimension lines used to the method of noting changes on a drawing.

Elements of Refrigeration. By Arthur M. Greene, Jr. Pp. 451, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.50.

This is a thorough discussion of refrigeration including both the theoretical basis and the practical application. However, the work is arranged in such a way that the 'practical' man, whose training has not been sufficient to enable him to follow the mathematical deduction of formulas, will nevertheless find the book useful. After a brief introduction dealing with fundamental principles, the book considers the various methods of refrigeration. Then follows a discussion of the thermodynamics of refrigerating apparatus and a description of the various types of apparatus. Further discussion of heat transfer and insulation leads to the consideration of cold storage. Chapters following this deal with ice-making and with miscellaneous applications of refrigeration. The next chapter is devoted to costs and the final chapter to the solution of a number of problem dealing with practical applications of refrigeration.

Millwrighting. By James F. Hobart. Pp. 438, ill., index. The McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.

Under the term millwrighting, the author includes the construction of industrial buildings, and the book will be valuable to those engaged in both design and construction. The first few chapters are devoted to the laying out of buildings and the use of the various instruments employed for this purpose. Then come several chapters devoted to the erection of buildings and the design of structures, including the strength of materials. The remainder of the book may be said to deal with the special problems of the construction of industrial buildings. The several chapters discuss shafting, pulleys, belts and belting, setting-up machines, babbitting, steam and water-pipe fitting, erecting steam-engines, setting steam-boilers, water-wheel setting, and installing electric motors. The book is well-illustrated and the treatment is clear and suited to the needs of the 'practical' man.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

USE OF TRAILER WITH MOTOR-TRUCK

The accompanying illustration shows a three-ton motor-truck trailer manufactured by the Troy Wagon Works Co. put to excellent use. Together the truck and trailer are loaded with 21 light six touring car bodies, which is the number that can possibly be loaded in a 40-ft. railroad car. These bodies were transported from Muncie, Indiana, to Springfield, Ohio, a distance of approximately 100 miles. The round trip is made in 20 hours, and this includes the loading and unloading time. The average speed on the road is about 15 miles per hour. Under normal conditions it would require by rail, one week to get the bodies, which they

A. S. Winter, formerly advertising and sales manager for the Wm. Powell Co., has joined the sales force of **The Fair-Banks Company**, Pittsburgh, Pennsylvania, and will represent them in southern Ohio.

R. A. Orrett announces that he has withdrawn from the firm of Griffin Company and has established offices in the Mills building, San Francisco, under the name of **R. A. Orrett Company**, whose services are available as general purchasing agents.

The **Hardinge Company** is distributing convenient loose-leaf sheets, suitable for filing in the Lefax note book, which give detailed information and data on grinding in ball and



Automobile Bodies Transported by Motor-Truck

get by overland transportation in 20 hours. Shipping the bodies by truck and trailer is a little more expensive than by rail, but owing to the delay which the railroads would cause there is economy in using truck and trailer, from the fact that deliveries are not held up.

In bad weather these loads are covered with a large canvas envelope which fits closely over the bodies on both the truck and trailer. The weight of each body will average about 500 lb., making a total load of only 10,500 lb. In this particular case, it is not the weight of the load that counts, for, as in many other cases, the load bulks considerably and there is still no weight of any consequence.

COMMERCIAL PARAGRAPHS

A catalogue entitled 'Reversible Ratchet Wrenches' has been issued by the **Lowell Wrench Company** of Worcester, Massachusetts. A complete line of wrenches for various uses is described and illustrated.

B. M. Snyder, for the past ten years in consulting practice in Los Angeles, has become a member of the **Southwestern Engineering Company**, of that city, and will fill the office of secretary and treasurer of the corporation.

tube-mills, based on operations at different plants. These will be followed by others of similar nature, and in the same convenient form.

The **Booth Electric Furnace Co.** has opened an office at Detroit in charge of M. A. Beltaire, Jr., at 805 Hammond building, and another at Birmingham, Alabama, in charge of Gassman & Cunningham, Brown and Marx building. The Booth company reports the sale of 20 rotating electric brass furnaces which includes a number of repeat orders. These orders cover all four sizes from 250 to 2000 pounds.

The **Wheeler Condenser & Engineering Co.** of Cartaret, New Jersey, has designed a new vertical jet condenser, the feature of which is a vertically split casing on the tail pump. This feature permits easy and quick removal or inspection of the pump-rotor or other internal part. It is now simply a matter of removing the bolts and cover, and uncoupling the rotor. Before this design was developed, considerable time was required to get at and remove the rotor.

'Centrifugal Pumping Machinery' is the title of Bulletin H-4, recently issued by **Lea-Courtenay Co.**, of Newark, New Jersey. The pamphlet sets forth in a clear and concise manner the features of the various types and sizes of centrifugal

pumps manufactured by the company. It is profusely illustrated with cuts of individual machines as well as with views in the company's shops, and installations of the pumps in various commercial plants throughout the world. The foreword says "quality is the most essential attribute of a pump", and this has been the aim of the Lea-Courtenay organization.

The Yuba Manufacturing Co. in the winter number of the 'Bulletin' features Model 20-35 ball-tread tractor. Two years ago an order was placed for a tractor with an over-size motor, designed to compensate for loss of power due to working at an elevation of 5000 ft. It was found that there was less wear and tear, that the clutches were relieved of overwork, and that the tractor gave a better performance in every way. Accordingly the standard 20-30 model is now equipped with the larger motor, and all orders will be filled with this style of machine unless otherwise specified.

The Chicago Pneumatic Tool Co. on January 21 and 22 held a general conference of executives, plant and branch managers, and salesmen at its Detroit plant on the occasion of the formal opening of a large five-story addition. At this conference the expansion program of the company for 1920 was outlined, calling for largely increased production not only at Detroit but at the five other American plants. It was reported that much of the proposed increase in production was already absorbed by orders for future deliveries. The nation-wide chain of 'service stations' which the company has opened and supplied with complete stocks of spare parts, machinery, and tools, and provided also with facilities for handling territorial repairs for users of the company's products, was also outlined in detail.

The Cutler-Hammer Mfg. Co., of Milwaukee, has made an addition to its line of enclosed starters. The enclosed feature removes all danger of exposed parts and protects the button and segment contacts from damage due to fine collecting dust or spraying water. This starter, known as Bulletin 2111, is very desirable for small direct-current motors in exposed locations driving line-shafts, fans, blowers, pumps, drills, and small motor-generator sets for arc welding. It consists of the familiar type of direct-current hand-starter enclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter. The external, or operating lever, is insulated from the revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate to the workman whether the starter is 'off' or 'on'. A low-voltage release-coil in series with the shunt-field protects the motor in case of voltage failure or if the field should be opened while the motor is running. Both the enclosed and open-face type starters are made in various capacities up to 50 hp., operating at 115, 230, and 500 volts.

R. E. Fulton, vice-president of the International Motor Co., warns shippers to prepare now to meet the emergency arising from congestion in railroad transportation. He says: "During the congestion of 1917, the motor-trucks in use hauled 1,200,000,000 tons of goods, and this year with production greatly increased and the railroads crippled by the coal shortage, the demands upon the trucks will be many times greater. The inability of shippers of goods to get satisfactory service from the railroads has already caused many of them to use motor-trucks, and if the present demand keeps up, the production of high-grade trucks to meet the demand will be impossible. It is significant to note that the sales of Mack trucks last month increased 58% over the month previous, and that this heavy demand is increasing steadily. Another point that shippers should not overlook is that the railroads will be turned over to their owners soon, and that increased freight rates, as a result of this, are inevitable. The Esch railroad bill, which aims to give the

railroads a helping hand during the period of transition, has provisions which stipulate that the railroads shall immediately apply for increased freight rates. This certainty of increased railroad rates as well as the inadequacy of the railroads to give the kind of service that is being demanded, points to an oversold condition in the high-grade truck market before very long. Business men in order to be sure that their freight will be handled should place their orders for sufficient motor transportation now, while deliveries are obtainable. The increased demand for trucks from foreign countries will also have a big influence on conditions. Export sales of Mack trucks last month were the biggest yet, many going to Peru, Cuba, Norway, Argentina, Holland, and Mexico."

'For the Glory of America' is the title of an attractive and unusual book published by the companies of which Samuel W. Traylor is the founder and head. These include the Traylor Engineering & Manufacturing Co., the Traylor Shipbuilding Corporation, the Cement Gun Co., and the Traylor-Dewey Contracting Co. The book is a record of the activities of these companies during the past five years. Its principle theme is the part that the various Traylor organizations played in the Great War, to the successful termination of which they contributed more than an ordinary share. They played a prominent and creditable part in the activities on the 'Home Front' which as they say "is that vast array of factories, extending throughout the length and breadth of this great country of ours, whose tireless activity furnished the wherewithal to do battle in the cause of Liberty". The manufacturing company made shells, marine engines, marine boilers, and the 'Master Road Builder' a combined elevator and crusher which did excellent service in making roads for the troops in France. When the call came for cargo boats, the Traylor Shipbuilding corporation was organized and was among the first to turn its energy toward the building of 3500-ton wooden ships. The Traylor organization has long enjoyed a world-wide reputation as a producer of mining, milling, and smelting machinery, and its enterprize and patriotism during the War entitle it to a deal of credit. No one can begrudge the Traylor companies the self-satisfaction which they express in this really handsome book.

Edward D. Kilburn, who since March 15, 1917, has been New York district manager of the Westinghouse Electric & Manufacturing Co., was recently elected vice-president and general manager of the Westinghouse Electric International Co. Mr. Kilburn graduated from Cornell University, and immediately entered the employ of the Westinghouse Electric & Manufacturing Co., for a number of years being at the Syracuse office of the company. Subsequently, he was transferred to the Westinghouse Machine Co. with headquarters at New Haven, Connecticut. In 1915 he returned to the Electric company as manager of the power division of the New York office. A year later he was also made manager of the railway and lighting divisions, subsequently becoming manager of the office. Maurice Coster, who has been actively engaged for more than thirty years in handling the foreign interests of the Westinghouse company, continues as vice-president of the International company with advisory duties. The president of the International company is Loyall A. Osborne, who is senior vice-president of the Electric company and was actively engaged in national work during the War, having been chairman of the executive committee of the National Industrial Conference Board, chairman of the committee of the Council of National Defense, a member of the National War Labor Board, and other important bodies. The Westinghouse Electric International Co. was formed in the spring of the present year to succeed the Westinghouse Electric Export Co. It handles the Westinghouse foreign business and is world-wide in its scope.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICHARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Desney Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, FEBRUARY 28, 1920

\$4 per Year—15 Cents per Copy

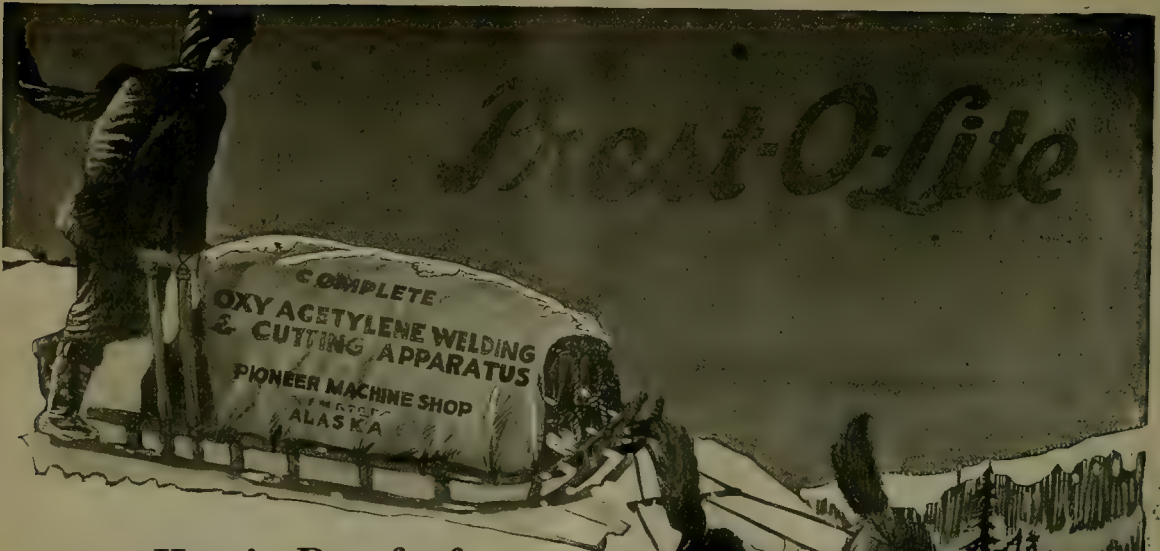
TABLE OF CONTENTS

	Page		Page
EDITORIAL		City station of U. S. Bureau of Mines. Arrangement. Equipment. Schemes for facilitating work.	
NOTES	293	THE COMBINATION METHOD OF MINE-SAMPLING	
THE LEASING ACT	295	By Morton Webber	303
End of a long fight in Congress. Wording of the last clause to be amended. The distribution of the money received under the Act. Areas allowed for the working of various mineral deposits. Extent of territory affected. Quieting of lawsuits pending over oil-lands in California and Wyoming.		Recent discussion of former article. Sources of error in hand-sampling. Latent sampling-error. Questions asked by other engineers. Answers. Fluctuations in 'degree of error'. Secondary enrichment does not vitiate combination method.	
GOLDFIELD CONSOLIDATED	296	VALUATION OF OIL PROPERTIES FOR FEDERAL TAXATION	307
Preparations to re-start the old mill and to mine remnants of ore in the old workings. A reminder of the gay days of 1906. Reminiscences of a picturesque period. Ups and downs of the Goldfield district.		The report of a committee named to formulate an equitable method for valuation as of March 1, 1913. General conditions in 1913. Trend of prices. Consumption approaching production. The scale recommended. The calculations involved. Conclusion.	
DISCUSSION		MR. HOOVER'S ADDRESS AS PRESIDENT OF THE AMERICAN INSTITUTE OF MINING ENGINEERS ON FEBRUARY, 17, 1920	315
PROHIBITION		Newly aroused interest of engineers in national affairs. Credit inflated. Return of railways to private operation. Demobilization of cargo fleet. Reorganization of government departments. Public works. A national budget. Industry and industrial relations. Our social philosophy. A middle course dominated neither by the 'interests' nor by radical socialism.	
By F. J. Bourne.....	297		
Opposes the good-tempered acceptance of a bad law. Many prohibitionists overlook the constitutional rights of the individual.		NOTES	
THE MINING INDUSTRY IN AUSTRALIA		ANTIMONY AND ITS USES	299
By E. A. Weinberg.....	297		
The future of Australian mining is not promising. Protest against condemnation of German metal-buyers. Germans were more progressive than competitors.		DEPARTMENTS	
STOCK-RAISERS AND MINERAL LANDS		REVIEW OF MINING	319
By L. A. Fenner.....	298	THE MINING SUMMARY	325
Conflict between placer locations and subsequent stock-raising homestead entries. Cattle and sheepmen 'grabbing' land. Miner excluded.		PERSONAL	326
ARTICLES		THE METAL MARKET	327
A CHEMICAL LABORATORY		EASTERN METAL MARKET	328
By John C. Morgan and Edward P. Barrett....	300		
Description of analytical laboratory at Salt Lake			

Established May 24, 1860, as The Scientific Press; name changed October 24 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



Here's Proof of "The Universal Service"

ALASKA or Atlanta—no matter where you do business—you'll find one of the 40 Prest-O-Lite Plants and Warehouses your best and handiest source of acetylene supply.

Wherever repairs are needed, there you will find good welders using and depending upon

Prest-O-Lite

DISSOLVED ACETYLENE

The Universal Gas With The Universal Service

Prest-O-Lite Service goes wherever you can go; does any kind of a welding or cutting job for the least time and money cost.

*Write
for the Service Plan,
It's Interesting*

THE PREST-O-LITE COMPANY, Inc.

General Offices

50 East 42nd Street, New York

Kohl Building, San Francisco

In Canada

PREST-O-LITE CO. OF CANADA, Limited
Toronto





T. A. RICKARD. . . . Editor

IN our last issue we published an article on 'Mining Exploration', by Mr. J. H. Farrell, intending to draw attention to it, as it deserves. We venture to ask mining engineers to turn back to it, if they have not read it already, because it deals with an important subject, which Mr. Farrell has discussed in a suggestive manner. Contributions on the subject are invited.

AN interesting decision in a controversy involving the ownership of a mining claim in the Kirkland Lake district has been rendered by the Mining Commissioner of Ontario. The original locator of the claim proved that he had paid more than \$200 to certain miners, who, in return, furnished a sworn statement to the effect that they had properly performed the required assessment work. It appears, however, that they had falsified this statement and that in reality they had done nothing on the claim. A subsequent location was duly made and the Commissioner settled the contest that followed by deciding in favor of the re-locator. Despite some adverse comment, we believe the decision to be sound. While it may work some hardship on non-resident owners, the obvious opportunity for fraud, and serious complications that might develop whenever a claim became particularly valuable, would seem to put the alternative decision out of the question.

DELAY in the receipt of the text of Mr. Hoover's speech on February 17 compels us to place it at the far end of this issue. We are glad to give it verbatim to our readers because it is not only the speech of the president of the American Institute of Mining and Metallurgical Engineers, the organized body of our profession, but also the public utterance of a Presidential candidate, that is, one whom a large proportion of the American people regard as a candidate. Apropos of this, we were amused several months ago when we told a friend that Mr. Hoover had accepted the nomination as president; he, off his guard for a moment, looked keenly interested, but when we explained that it was only our Institute of which he was to be president, his look of disappointment was delightful. We do not depreciate the character or function of the Institute by telling the story; indeed, it is a happy coincidence that Mr. Hoover should have been elected to the chieftainship of the mining profession in the United States at this time when most engineers and other professional men all over our country are expressing a keen hope that he may be offered, and that he may

accept, the nomination to the highest office in the land. Those who read the speech delivered before the Institute will find further reasons for justifying them in their purpose to elect him not president only but President.

ENTRIES of lands covered by mining locations have been made by stock-raisers in Montana, and Mr. L. A. Fenner contributes a letter on the subject in this issue. It appears, on enquiry at the General Land Office, that claimants of valid locations made prior to any right to the land under the stock-raising Act of December 29, 1916, are entitled to both the surface of the claim and to the minerals covered by it, but as neither the local offices nor the General Land Office have records of mining locations prior to the filing of applications for patent, it becomes necessary for the mineral claimant, where his ground has been included within a stock-raising entry, to file a duly corroborated protest in the local land office, together with a request for hearing in order to establish the mineral character of the land and the prior initiation of his right thereto. We are much obliged to Mr. Fenner for calling our attention to this matter, which may concern many of our readers.

UPON another page we publish an article by Mr. Morton Webber on the sampling of mines. It is a subject on which he is an acknowledged authority and one which is of perennial interest to those engaged in mining, more especially to the engineer whose duty it may be to appraise mines for his clients. In the present article Mr. Webber responds to a request to describe in greater detail the use of mill-tests as a check on mail-sampling. More than two years ago he outlined this 'combination' method in our columns, and elicited a useful discussion, in the course of which other engineers asked for further information concerning this means of correcting conclusions based upon the ordinary methods of sampling with the moil and hammer, otherwise called hand-sampling. The idea is to detect the errors latent in the usual procedure by means of milling a considerable tonnage of ore from one or two representative stoping-areas. He does not discuss the subject of a preference as between sampling a mine by means of a few large lots of ore and sampling it by means of a great number of cross-sectional groovings, but he is advocating the use of the bulk method as a means of ascertaining the inaccuracies lurking in the fragmental method. Nor does he dwell particularly on the use of the mill-test as a

metallurgical experiment; he has in mind the one object of preventing error by means of a check. As an example, he describes his procedure when sampling a low-grade gold mine in Central America. This description serves to illustrate another feature of such technical work, namely, the variation in the degree of discrepancy between the hand-sampling and the mill-testing, which he recognizes and overcomes by decreasing the interval between areas subjected to milling, as the circumstances may require. He discusses the application of this combination method to low-grade copper mines and illustrates his suggestions by means of a diagram. We have found the article interesting and useful, and we feel sure that it will be appreciated both for its direct information and for its indirect suggestiveness. Any further discussion by experienced men will be welcomed.

WHAT line of attack the political machines intend to develop in their opposition to Herbert Hoover's candidacy is indicated by Mr. Samuel Untermyer's assault upon Mr. Hoover appearing in the Hearst papers, which afford a fit medium for the purpose. To mining men who recall Mr. Untermyer's association with the Guggenheims in the Nevada Consolidated deal, and with other phases of predatory finance, it was amusing to read the expressions of unctuous rectitude published last Sunday from the friend of Tammany Hall. Mr. Untermyer, who has participated in many a shady mining deal, talks semi-religiously and on a Sunday about "the natural resources of the world that should belong to the people" and has the impudence to make sinister allusions against a man who by his public work during the five years of world crisis rose to the greatest heights of beneficent effort in behalf of the suffering peoples of the world and in behalf of the welfare of his own country. It is to laugh; of course Tammany Hall, Hearst, the Sam Untermyers, and their like will fight Hoover. That is why the rest of us love him.

ATASCADERO is a euphonious Spanish name associated now with the publication in California of an attractive monthly periodical called 'The Illustrated Review'. The publisher is Mr. E. G. Lewis, to whose mine-promoting activities we have referred more than once. Somebody has sent us the latest issue of this magazine and has marked page 26. On turning to that page we note a report by Mr. C. E. Gilman on two oil ventures in Montana. We are told that "the formation bed is lime and the cap rock is soft shale". This is not exactly nonsense, but it is near it. The same remark applies to the report as a whole. Mr. Lewis explains that as editor of 'The Illustrated Review' he "has neither oil nor mining stock for sale" but "being personally interested in both these properties, through his corporate firm of Lewis, Gilman & Moore", he makes the following proposition to the readers of his 'Review': he will "present a one-twentieth interest in both" the Omega mine in Tuolumne county, California, and "his interests in the new oil-field" to each subscriber "sending in ten new subscribers

at \$1 for three years each or one new life subscriber at \$10". Here is another scheme for circumventing the Blue Sky law. Mr. Lewis is too generous, it seems to us, if the gold mine and the oil-field have any sort of value. To receive a twentieth of such potentialities of wealth as a commission on \$10 seems too much like giving things away, especially as the 'Review' is really a most interesting and attractive publication. Our advice, to anybody caring to have it, is to subscribe for Mr. Lewis's publication and take damned good care not to buy shares in any of his mining schemes.

AS the idea of discarding the use of silver in subsidiary coins has been suggested, the question of the best substitute is now engaging attention. The principal requirements are that the metal or alloy of the coin be durable and difficult to counterfeit. The Swiss government has recently made tests to determine the resistance to abrasion displayed by coins of various composition. Pure nickel far excels the rest; bronze is second, and a copper-nickel alloy is next, the others included in the test being brass, copper-silver, and various aluminum alloys. Nickel when alloyed with 5% of other metals loses its undesirable magnetic property, and likewise is tarnished with difficulty. Two properties of this metal make counterfeiting peculiarly difficult, namely, its hardness and its high melting-point. In consequence, heavy machinery is required to make the impression on the coin in the first place, and when once properly made it is so distinct and well defined that the imperfections of an imitation are detected easily. The high melting-point will oblige the counterfeiter to provide an elaborate plant for melting the metal and cutting his blanks. Since the actual value of the metal constituting subsidiary coins is comparatively unimportant, the good points of nickel commend it for serious consideration in selecting a substitute for the silver now used in the mints.

WHETHER Congress will agree to place a \$500 duty on tungsten, in order to protect our domestic production of that metal, we do not know, but we are interested to learn of an enterprise in Korea that bids fair to compete with the American producer most successfully. The Chosen Minerals Company controls a concession at Neigetsu, in Korea, that is unique. It is a scheelite placer. The gravel averages 45 feet in depth, 200 feet in width, and is two miles long. The scheelite is recovered by ordinary panning, the work being done by natives. The deposit averages 15 to 22%, of which about 6% is lost, temporarily, in the tailing. The concentrate, which averages 70% tungstic oxide and is produced at the rate of 60 tons per month, is shipped to Liverpool, where it fetches \$7 to \$8 per unit. If the Japanese, who now control Korea, enact favorable mining regulations, it is probable that machinery will be placed on this placer for conducting operations on a larger scale. Meanwhile we are informed that the British are selling ferro-tungsten at 62 cents per pound, whereas it costs a dollar per pound to produce this alloy in the United States;

therefore, despite a 'differential', of 25 cents per pound, established on account of a better quality of material, the British product has a margin of 13 cents per pound on which to invade our domestic market.

IN this issue we publish an article on the valuation of oil properties—or, more properly, oil mines—for the purpose of determining the amount of the invested capital on which exemptions from the Federal income-tax are to be calculated. This is a matter of vital importance, because, if, for example, an oil venture that was capitalized at \$100,000 in the early days of oil exploitation, say, 20 years ago, succeeded in developing a \$1,000,000 enterprise, it has, according to law, an 8% exemption before the reckoning of the net profit begins, whereas if the corporation does not obtain a valuation of its property as of March 1, 1913, as allowed by law, whereby its capital is established at \$1,000,000, which was its true value, then the corporation will suffer a loss of \$72,000. The article is based on a report prepared by a committee of five Californian engineers, who were requested by the oil companies of California to make the investigation in order to aid the Internal Revenue Commissioner, as well as the owners of oil ventures, in ascertaining the best method for valuing this form of property. The report was not made as a brief for the oil companies, but on the understanding that it would be welcomed by the tax authority.

LAST week we discussed the award of a gold medal to Mr. Sulman by the Institution of Mining and Metallurgy, in London, on account of his "contributions to metallurgical science", particularly flotation. In a previous reference to the matter we criticized Mr. Sulman's failure to acknowledge the writings of precedent authors. In a later bulletin of the Institution we find an article on 'Froth Flotation: Its Commercial Application and its Influence on Modern Concentration and Smelting Practice', by Mr. Walter Broadbridge, metallurgical engineer to the Minerals Separation company. Capt. Broadbridge made an honorable record in the War and he is a man of the highest standing in the profession; we have no prejudice against him, quite the contrary, of course; but this paper of his is open to the same criticism as Mr. Sulman's in that it ignores all previous writings on his subject. Mr. Sulman discusses the physics of the flotation process; Mr. Broadbridge describes the machinery and methods used in applying it to the treatment of ores; both these gentlemen utterly ignore the papers published by the American Institute of Mining Engineers and by the American technical press during the time when they themselves chose to remain silent. Nearly all the information in Mr. Broadbridge's paper has appeared at various dates during the last five years in publications that should be accessible to him, and certainly are accessible to other members of the Institution. We would like to know whether the officials of the Institution in London have decided to disregard the unwritten rule that an author make acknowledgment of precedent writings on his subject, or is the infraction of this etiquette to be approved on the part only of the Minerals Separation

staff? We venture also to ask why the council of the Institution failed to award the second gold medal, the one placed at its disposal by the Consolidated Gold Fields company, to Mr. Broadbridge? Surely he is entitled to it, if Mr. Sulman is worthy of the premier prize. Putting aside the books on the subject published in this country while Messrs. Sulman and Broadbridge, willingly or unwillingly, were muzzled into silence; putting aside the voluminous contributions on the subject published in the 'Mining and Scientific Press', we ask how the council of the Institution, or whoever may be responsible, explains the manifest discourtesy to the American Institute of Mining Engineers in ignoring the valuable papers on the subject that appeared in the Institute's transactions, particularly in 1915 and 1916? Moreover, we ask again whether the Institution intends to place a premium on silence and on secrecy in the metallurgical art? The printing of these belated papers by the metallurgists of the Minerals Separation company, coming forward now with information that is years old, after their company had tried ineffectively to prevent the publication of such information by others, constitutes an impertinence, rendered all the more marked by the deliberate failure to make references to the current literature of the subject.

The Leasing Act

After a long fight in Congress the Leasing Bill, S. 2775, has been passed, with many amendments. The last clause to be adopted was the last paragraph of Section 19, which now reads: "All permits and leases hereunder shall inure to the benefit of the claimant, and all persons claiming through or under him, by lease, contract or otherwise, as their interest may appear: Provided that no claimant acquiring any interest in such lands since October 1, 1919, shall secure a permit or lease thereon under this section." The Bill provides that 10% of all moneys received from sales, bonuses, royalties, and rentals, except those from Alaska, shall be paid into the U. S. Treasury, leaving 37½% to the individual State and 52½% to the U. S. Reclamation Fund. This distribution was the result of protracted debate, ending in a compromise. Only minimum royalties have been fixed, not the maximum, which are left to the discretion of the Secretary of the Interior. The maximum area for a lease is fixed at 3200 acres for oil-lands, 2560 acres for coal, and 5120 acres for oil-shale deposits. This legislation is a complete reversal of the original land policy of the United States, which gave the right of patent for oil and other mineral lands, but rendered the privilege ineffective by a series of withdrawals of large areas by Presidential initiative, which the Department of the Interior followed by a policy of additions to the withdrawals, even in partly explored areas, after making secret investigations and filing secret reports. About 46 million acres of supposed coal-land in the West, about six million acres of supposed oil-land, and about three million acres of supposed phosphate-land are now opened to exploitation under a permanent leasing system. The fight has been long and costly, involving

a bitter controversy between those favoring Federal control as against State rights and affecting the long-drawn litigation arising from the withdrawal of oil-lands in California and Wyoming under the Taft administration. How many of the pending lawsuits will be quieted by defendants taking advantage of this enactment, remains to be seen. Many favorable oil-bearing formations will be thrown open to exploration, and a vast area of oil-land in Alaska will be freed for development. There will be a rush to Cold Bay, Illinania, and other districts in southwestern Alaska at once. Undoubtedly many phases of mining in the West will be stimulated by the greater freedom for prospecting in various parts of the national domain, and for that reason the mining community welcomes the Act.

Goldfield Consolidated

The preparations of the Goldfield Development Company for re-starting the old Consolidated mill to treat the remnants of ore in the old Mohawk, Combination, Red Top, and January claims, mark the beginning of another, and perhaps the last, chapter in the history of this rich bit of Nevadan desert. At the time when dozens of abandoned silver-mining districts are being rejuvenated and their mines re-opened after years of idleness, it is interesting to see that Goldfield, younger by a generation than the rest, more spectacular at its zenith, is also, as the local scribes would say, 'staging a come-back'. To those who have followed the career of Goldfield there is a tawdry romance in its history. The first discovery was made late in 1903 and during the two following years many claims, the January and Combination among them, were opened up; a number of small stamp-mills, in which amalgamation and concentration were followed by cyanidation or chlorination, were successfully operated, and later the railroad was extended from Tonopah. Then in 1906 the district started to boom; it became a little rougher and a little wilder each day until at the time of the Gans-Nelson fight on September 15, 1906, it was the rendezvous for the 'sporting' element from all over the country. Then came the first labor troubles, when George Wingfield, in the face of solemn warnings that anyone distributing a certain newspaper would meet instant death, advertised that at 12 o'clock noon he would sell the paper. This he did, walking out of Cook's bank with a six-shooter in each hand, thereby 'calling the bluff' of the union men and 'getting away with it'. It was not long before the mushroom camp had grown into a city of 30,000, including miners, gamblers, speculators, brokers, and adventurers of every kind. The old Northern saloon never closed its doors; for 24 hours each day and 365 days each year it welcomed patrons to the bar, the 'wheel', the 'bank', to 'stud', and to 'craps', 'earning' for its owners no less than \$100,000 net for many months in succession; and the Northern was one of 30 as popular, if not so well known, resorts. Meantime the lessees, among them the Francis-Mohawk and the Hayes-Monette partnerships, were gouging marvelously rich ore from the old Mohawk vein, the latter taking \$5,000,000 out of a

block 370 by 150 ft. Miners would refuse \$20 per day for work on development, preferring to accept \$5 on a lease that was in ore. No one, not even the assay-offices that bought the mineral, will ever know the value of the gold 'high-graded'—that is, stolen—by these miners. So rich was the ore and so short the time that a 50-horsepower hoist and eight rock-drills were sent from Chicago by express on the Overland Limited, so the story goes. Then the late George S. Nixon and George Wingfield organized the Goldfield Consolidated, which finally included the claims mentioned above together with the Jumbo, Red Top, and others. Mr. J. H. Mackenzie was resident manager for the company, and while still running the Combination plant, he built, in 1907, the new mill, a modern cyanide plant with 100 stamps. Mr. J. W. Hutchinson, who worked out an ingenious scheme for cyaniding the rich sulphide-concentrate, became superintendent; later he increased the capacity of the mill to 900 tons, and, including shipments of high-grade ore, the mine was producing nearly a million dollars per month in gold bullion. But the glamor was gone. The 30,000 inhabitants soon dwindled to 4000, and in September 1910 the law forbidding gambling in Nevada went into effect, and the last of the deft-fingered gentry migrated to more fruitful fields. Mr. J. R. Finlay managed the Consolidated during that year and he was largely instrumental in equipping the property for the lean years at hand. It was about this time that a certain elderly farmer from Massachusetts sent to Mr. A. H. Howe, treasurer of the Consolidated, an old certificate for a few hundred shares of Mohawk stock, which he had purchased for nearly nothing long before the consolidation; he asked that, if the certificate was worth anything, the proceeds be forwarded, and to his surprise he got a check for something over \$30,000, as Consolidated stock was then selling at \$20 per share. One wild-cat had made good! Later Mr. Albert Burch served as manager for a time and then Mr. Hutchinson was deservedly promoted to the position of general manager. The grade of the ore diminished; the old tailing from the cyanidation of the concentrate was roasted and most of the gold recovered; flotation was introduced, and used with some success, but the reserves of ore were being exhausted, costs were rising, and the Consolidated suspended operations in 1918. The district survived even this. Now comes the Development company, with a plan to cave large portions of the old workings, including pillars of ore and waste, and the stope-filling, and to treat the mixture in the Consolidated mill. During the operations of the Consolidated company hundreds of samples were taken daily to determine what material was ore and what was not, because it was impossible to distinguish by appearance; it seems reasonable to suppose that a good deal of valuable rock went into the stopes for filling, and it is quite possible that a satisfactory mill-feed can be obtained by recovering pillars and filling together, by a system of caving and glory-holing, as is planned. We wish success to this new departure, which is in the competent hands of Mr. A. I. D'Arcy.

DISCUSSION



Prohibition

The Editor:

Sir—As the author of the 'kick' against prohibition referred to in your issue of January 24, may I comment very briefly on your article on the subject.

You quote as foolish a man that pledges himself to vote against any candidate for public office, regardless of party affiliation, who favors the enactment of prohibition. There are thousands of men in Canada and the United States who have taken the same pledge as a protest against the folly and hopeless stupidity of the Act, which will make law-breakers, liars, and hypocrites of many erstwhile good citizens.

To accept quietly and good-temperedly a bad law that curtails the privileges of thousands for the sake of a few weaklings is not my idea of good citizenship or government by majority. Your article says: "Prohibition is a standing example of the fact that if you say the same thing often enough it will be believed by the average man." This is true also of Canada. We have had trick ballots, mis-statements, false statements by so-called evangelists. The frightful degeneracy of Great Britain has been drummed into us. If by tactics such as these he gets his laws enacted, I presume the citizen that does think must fold his hands and accept the inevitable.

If the early settlers in the U. S. A. had accepted the decision by the majority in England that they should pay taxes without representation, there would not have been any U. S. A. But these settlers, being liberty-loving people, made their kick and did not accept the decision of the majority with good humor.

Your article touches on the strict regard for the constitutional rights of the citizen. The average prohibitionist cares nothing for the constitutional rights of any citizen. He is out to fine or imprison any one (whether he abuses liquor or not) that will not obey the intolerant and tyrannical laws he has enacted. That this attitude is undemocratic and is class legislation of the worst type does not bother him, as he can always get some half-baked legislator or hysterical parent to back him up.

The concluding paragraph of the article is stock prohibition stuff. The drunkard's wife and the temptation to the child always (like the death of Lady Isabel in East Lynne) brings down the house. The "I didn't raise my boy to be a soldier" sentiment is dear to the heart of a prohibitionist.

There are today scattered over France, Belgium, and many other parts of the world the bones of many of Great Britain's best sons. Many of these were public-

school lads who left home at an early age to receive their education. When the call came, they went and did their duty; and it is well to remember that most of the parents of these lads had (what is far better than silly laws) a supreme confidence in the manhood of their sons.

There is little credit to be gained in raising a boy as a hot-house flower, if after he takes his place in the world, he cannot resist temptation.

In conclusion, Sir, I cannot congratulate you on your article. To class as fools people that respect the rights of others and are in favor of a sane government is not good argument, as good citizenship calls for individual thinking and effort, not blind obedience to the mob—although (as Stephen Leacock says in his admirable article against prohibition) "one always has the privilege of leaving, and living in the South Sea Islands or some civilized country. Let us thank God for this amount of freedom".

F. J. BOURNE.

Cobalt, Ontario, February 10.

[We have had our say. Mr. Bourne is welcome to his.—EDITOR.]

The Mining Industry in Australia

The Editor:

Sir—As one, who has contributed his share toward the mining and metallurgical development of Australia as witnessed by the period from 1888 to 1914, I was naturally interested in the resumé on the present state of the mining industry in Australia written by my capable friend Mr. F. H. Bathurst, and published in your issue of January 31.

His clear and concise summing up of the causes, which have been mainly responsible for the depression prevailing at present in a once prosperous industry, leaves no doubt that the end of mining for non-ferrous metals can be foreseen within measurable time, and that, in the absence of new discoveries, the future of Australian mining and metallurgical development will be restricted to iron and coal and possibly to a few hydro-electric installations for the treatment of Broken Hill and Tasmanian zinc concentrates. Obviously the success of the latter would depend greatly on the ruling price for spelter, and such economic factors as coastal and over-sea freight-rates.

Mr. Bathurst, in the opening paragraph of his article, makes brief reference to the attempt of Mr. Hughes, the present Prime Minister of the Commonwealth, to eliminate forever the so-called dominance that the large Ger-

man metal houses are supposed to have exercised over the metal trade of Australia. During the War the group of German metal-merchants interested in this business was conveniently referred to as the 'metal octopus', with the apparent intention to convey to the world at large the magnitude and character of a monster sucking the very life out of the Australian mining industry. As no attempt has ever been made to submit a different version, it may be of general interest to analyze somewhat closer the above contention, in order to arrive at the actual condition of the Australian metal business, as it existed shortly before the War. Having been for many years a producer of metal and furnace products in Australia, mostly on behalf of English and Australian concerns, I am perhaps qualified to speak with authority on the whole question involved.

In the first place, it was customary for all large mining and smelting companies that were in the open market for the sale of their products to invite tenders and to sell to the highest bidder, whereby British, Belgian, and American metal-refiners and merchants had the same opportunity to compete for the business as the German metal firms. That the German houses have been more successful in their bids, speaks, after all, well for their superior organization, more particularly in connection with the business for Broken Hill zinc concentrates. The latter, of course, was so much involved with shipping rates for Europe, that these were at times a deciding factor in securing or losing a given contract.

Considering now that the price of spelter previous to the War stood under £26 per ton, I maintain that the German metal firms in spite of it enabled the Broken Hill mines to dispose of their zinc concentrates at a profit and thus placed them in a position to fully develop the various flotation processes that are now in use at Broken Hill and elsewhere in the world.

The period of this development falls into the decade previous to 1914, and I am sure there are many Australian mining men today who, in all fairness, will admit that the strictly commercial services rendered by these German metal firms were on the whole satisfactory and to the benefit of the Australian mining industry.

So much has been said and written about a deep-laid German conspiracy, which had the object of monopolizing the Broken Hill zinc concentrates to the detriment of Australian and British interests, that it is about time to tell the truth. The whole business was one of gradual development, and as British zinc-smelting works failed to rise to the opportunity and Americans were handicapped by excessive freights, the German metal houses secured the business *only* by providing the additional furnace-capacity, which was required to handle the increasing tonnage of Broken Hill concentrates. As this involved a large capital outlay it was, of course, necessary to make lengthy contracts for concentrates, and that is about all there is to the great conspiracy. That the Germans after all may be the losers by their greater enterprise, Mr. Hughes does not tell us.

However, I am making these correcting statements

without any animosity toward Mr. Hughes; he no doubt thought of fulfilling a great patriotic duty, when he decided to eliminate the German metal-buyer from Australia forever, though it reminds one somewhat of the man who cuts off his nose to spite his face.

I hold no brief on behalf of the German metal-merchants, neither am I under obligation whatever to any of them, but, having in pre-war times done business with them, I am not afraid to raise my voice in protest against all the misleading statements which have been spread about this Australian metal business.

New York, February 11.

E. A. WEINBERG.

[Mr. Weinberg is well known to us by reputation, and we are glad to publish his letter. The apathy and lack of initiative displayed by the English and Australian dealers in metals, particularly those engaged in the metallurgical business, did undoubtedly play into the hands of the German Jew combination, but that does not alter the fact that the Zinc Kartel and other German metal-buying organizations did use objectionable methods, more particularly in their relations with the Belgian zinc-smelting establishments. Combinations are unpleasant at their best, and the mining industry of Australia, as of the United States, will be wise in trying to frustrate the formation of any such combination of Jews or Gentiles as may obtain the power to throttle its industry by obtaining complete control of the refining and selling of the metals.—EDITOR.]

Stock-Raisers and Mineral Lands

The Editor:

Sir—I am herewith enclosing information that I thought might be of interest and help to the mining fraternity. I read in your paper about a year ago where one of your subscribers, by name, Bush, down in Arizona, had valid mineral locations on a copper lode, and one of the big cattlemen had a cowpuncher file on a stock-raising homestead that included mineral locations. Said Bush appeared to think the mineral locator was thereby wiped off the map. A case somewhat similar took place in this county. A party had several placer locations on which he had done the required assessment work for years, in fact, he had made his home on the land, had a garden, etc. Along comes another party who files a stock-raising homestead entry including therein mining locations. In the course of human events, said entry is allowed by the Land Department, and the entryman gives mineral locator notice to get off the earth. Others in the same locality have been and are up against the same proposition of contesting their homestead claimants. And I have been bucking one of the breed for three years as one of six placer locators: and only succeeded in getting part of the entry disallowed. And another entryman grabbed the whole of the location in another section before I knew he had even filed on the land. The intention of the homestead law is all right; but it doesn't always work out in practice as intended. Here in Montana the sheepmen and cattlemen were grabbing big chunks of landscape

under the 320-acre homestead law by putting a herder or puncher on for a few months each year; then along comes the 640-acre act which gives them a chance to annex bigger chunks. Sheepmen even go so far as to offer an outsider \$3000 or \$4000 to file and prove up on a homestead. Sheepmen get to fighting among themselves out on the open range; and land under fence is more desirable. The range for the cattle and horses belonging to small owners is becoming more restricted every year.

Under the rules for filing upon stock-raising homesteads, all mineral rights are reserved to the United States; a mineral locator has a right to go upon lands included in a homestead to prospect, mine, and remove the minerals therein during the time the entryman is proving up; also after issuance of patent. If I understood my lawyer-friend aright, in practice it works out that once a homestead entry is allowed, the sign up for the mineral locator is: "You can look but you must *not* touch." Verily the way of the lawmaker passeth understanding.

L. A. FENNER.

Virginia City, Montana, February 5.

Antimony and Its Uses

Antimony occurs chiefly in the form of sulphide or oxide in deposits which contain only antimony, or else is associated with lead, with lead and silver, or with gold. Many lead ores contain small amounts of antimony and in the processes of lead-smelting the antimony is collected as a by-product known as hard or antimonial lead, containing 5 to 7% antimony. It may also be made by mixing antimony ores with lead ores and smelting them together. This hard lead has a great variety of uses. For the ten years preceding the War the production of antimonial lead in the United States ranged from 10,000 to 15,000 tons per year, roughly two-thirds of this amount being produced from domestic ore, and one-third from imported ore. Antimony and its compounds have a great variety of uses. Besides that already mentioned the principal are the making of bearing-metal alloys, many of which contain considerable amounts of antimony; type metal, to which antimony imparts the property of expanding on solidification, thus yielding perfect letters; Britannia metal, used for tableware, toys, and so forth; and for a variety of minor purposes. A lead-antimony alloy is also coming into use for the sheathing of electric cables. Antimony sulphide is used in making matches and also in making red rubber. The oxide is used in making enamels and as a substitute for tin oxide in making bath-tub enamels and is quite important.

All of these uses, however, do not bulk very large in the metallic output of the world, and before the War antimony was considered a minor metal. The War changed this by creating a large use for antimony in shrapnel bullets, which contain 12% or more of antimony. The result was a large increase in production and price. The price, which before the War had ranged from 7c. to 8½c. per pound, rose to 40c. per pound in December 1915, and fluctuated during the War period, according to

trade conditions and also as military opinions varied as to the relative value of shrapnel and high-explosive shell in combat work. After the armistice the price rapidly declined and recent quotations have been about 9c. per pound. Presumably the stock of shrapnel on hand in the different countries is amply sufficient as a reserve stock for possible future wars, so that this use for antimony may be considered as non-existent and may possibly never occur again if the League of Nations proves effective, or if some substitute for shrapnel is discovered before another large war occurs.

Twenty-eight gold dredges were operated in Alaska in 1918, producing \$1,425,000 worth of gold, according to a report on the Alaskan Mining Industry just issued by the U. S. Geological Survey. Twenty-one dredges were in Seward Peninsula, three in the Iditarod district, and one each in the Fairbanks, Circle, Yentna, and Kuskokwim districts. These dredges handled about 2,490,000 cu. yd. of gravel. In 1917, 36 dredges handled 3,700,000 cu. yd. of gravel and recovered gold worth \$2,500,000. The average recovery of gold per cubic yard was about 57c. in 1918 and 68c. in 1917. The gold dredges of Seward Peninsula produced gold worth \$466,000 from 1,164,000 cu. yd. of gravel, making an average recovery of 40c. per cubic yard in 1918. The dredges of the Alaska Yukon districts produced gold worth \$881,000 from 1,125,000 cu. yd. of gravel, with a value per cubic yard of about 78c. Though dredges were built for use in the Alaska Yukon as early as 1898 and at Nome in 1900, this method of placer mining did not reach a profitable stage until 1903, when two small dredges were successfully operated in Seward Peninsula. Dredging began in the Forty Mile district in 1907; in the Iditarod, Birch Creek, and Fairbanks districts in 1912; in the Yentna district in 1916; and in the Kuskokwim region in 1918. A new dredge was installed in the Fairbanks district in 1918 and may have begun operating late in the season. The new dredge on Candle creek, in the Kuskokwim region, was completed in 1918 and operated for a short period. Up to the end of 1918 gold to the value of \$19,035,000 had been mined by dredges. The relatively low recovery of the dredges in 1918 was due, in part, to the unusually large amount of frozen ground encountered in Seward Peninsula.

In view of the wonderful attainments of the safety movement in the past few years, during which time the hazard of the mining industry has been greatly reduced, it is believed that all risks can be lessened. Personal injuries will always accompany industrial activities. Mining will never be free from accidents, for many of its hazards are inherent to the industry, but the progress already made gives assurance that all such hazards can be greatly reduced. Safety measures are not intended to eliminate the need of personal thought and alertness, as careful men are always better than safety devices, but are essential for the protection of workmen who carelessly or unavoidably expose themselves to existing dangers.

A Chemical Laboratory

By JOHN C. MORGAN and EDWARD P. BARRETT

*The large volume of analytical and chemical work in connection with metallurgical testing at the station of the U. S. Bureau of Mines at Salt Lake City made it necessary to have a laboratory equipped with all the appliances used in the rapid and accurate determination of the common elements. It is advantageous that results on tests be known not later than the day following the tests and these analyses must be accurate because all metallurgical testing is dependent upon the chemical analyses of the products.

The floor-plan is illustrated in Fig. 1, which shows that everything is compact and convenient. The chemist can stand in front of the hot-plate and transfer a series of beakers from the plate to the filter-table. The end-com-

Each of the filter-tables is fitted for 40 filtrations, the back row of funnels draining into a trough. The use of this row of funnels in filtrations from which only the precipitates are desired saves considerable time, for it is not necessary to place a beaker to receive the filtrates, and, of course, this decreases the amount of glassware needed, besides eliminating a great deal of dish-washing. The general plan of construction of the table-tops is clearly shown in the photograph. These tops are so made that the funnel-racks can be quickly removed, giving a flat-top table for use should necessity demand. Each table has three drawers in which may be placed filter-papers, cover-glasses, stirring-rods, etc. A shelf the entire size of the table is placed about eight inches above the

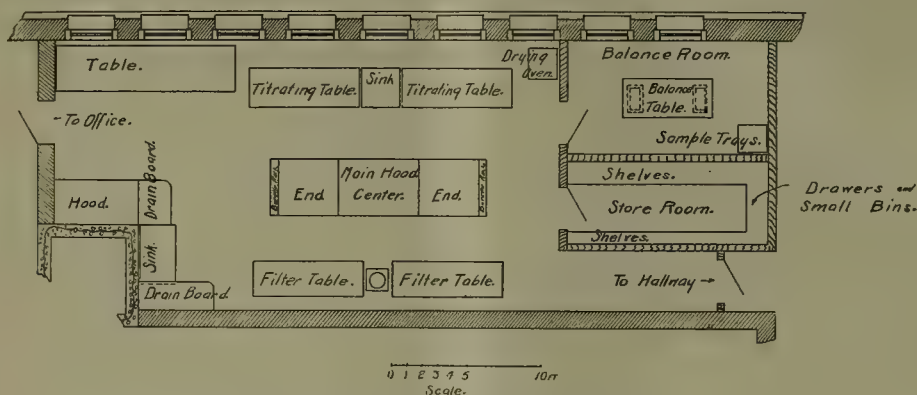


FIG. 1. FLOOR PLAN OF LABORATORY

partments of the central hood are each equipped with large gas-heated hot-plates. These two hot-plates and two filter-tables are arranged so that two chemists may work at the same time without interfering with each other's work. The central hoods have sliding windows so that the hot-plates may be used from either or both sides, which is a great advantage in titrating, especially in case the titration is made in a heated solution, since the titrating tables are directly opposite the hoods and in the same relative position as the filter-tables. The large sinks and drain-boards are placed so as to serve the hoods, filter, titrating, and general work-tables. The hood and work-table in the end of the laboratory are arranged for any special work, making an individual laboratory without isolation.

Fig. 2 shows the filter-tables, sink, and drain-boards, the three-compartment central hood, an end view of another hood, the hot and cold distilled water systems, and the motor-driven exhaust fan connected to the hoods.

*Published by permission of the Director of the U. S. Bureau of Mines. The photographs are by R. E. Head.

floor, thereby affording a convenient place to keep the trays of beakers and flasks, and it may also be used for reagent-bottles. Each table is supplied with a connection to the main vacuum system, so that it is also possible to make suction-filtrations on this table.

The large sink in the background is two feet by four feet, inside dimensions, and is supplied with hot and cold water. There are two drain-boards, one of which is two feet by five feet, and the other two feet by three and one-half feet.

The central hood has three compartments, the end compartments each being equipped with a gas hot-plate 36 by 18 inches. A plate of this size is large enough to accommodate all the heating operations necessary to keep one chemist busy with routine analyses. On the outside of the ends of the hood are supports for the 250-cc. dispensing-burettes, which are used in place of the ordinary 8 or 16-oz. reagent-bottles for the common acids. See Fig. 3 for a view of these supports with the dispensing-burettes in place. Also note the funnels underneath each burette to catch any drip and prevent acid from getting



FIG. 2. INTERIOR OF CHEMICAL LABORATORY



FIG. 3. ANOTHER VIEW OF SAME

on the floor. There is a shelf under the hoods on which the reagents are kept, 2½-litre bottles being used for this purpose. The central compartment is equipped with an electric furnace of the replaceable unit type and an electrically heated water-bath. The electric furnace is used for all ignitions of precipitates, annealing of gold beads, determinations of ash in coals, and sintering of ores in the determination of sulphur by the Eschka method. The hoods are piped with gas, water, vacuum, compressed air, and drain systems, and are supplied with 220-V. A. C. circuits. A Sirocco exhaust-fan, driven by a one-horsepower motor, removes fume from the hoods.

A shelf on the outside of each end compartment of the hood carries the tanks for the distilled-water, which is piped through copper tubing to each filter-table, to each compartment of the hood, and to the titrating-tables. One tank is fitted with an electric-heating device that furnishes hot water to the filter-tables in a short time after closing the switch, the other tank supplying cold water.

Fig. 3 shows the opposite side of the laboratory from that shown in Fig. 2. The opposite end of the central hood with the dispensing-burettes and supports is shown in the centre. At the right in the immediate foreground can be seen part of the fourth hood, which is equipped with an electric hot-plate. On the left is a general work-table, showing the drawers and the shelf underneath. This table is connected to gas, water, vacuum, compressed air, and drain systems, and with the hood opposite is used for special work.

In front of the central hoods are two titrating-tables between which there is a large sink, fitted with a device for maintaining a constant water-level, so that it may be used for the rapid cooling of heated solutions. This is a great convenience, especially when the chemist is making a large number of routine determinations. The shelves above these tables are for the bottles of standard solutions and are of sufficient height so that the siphons will easily fill the burettes. The supports for the shelves are made from standard iron pipe and fittings, as are also the supports for the burettes. These supports are painted dull black and the table-tops are painted white in order to furnish good lighting conditions for titrating. Each table is made with drawers long enough to accommodate burettes and with a shelf underneath. At the other end of the titrating-tables is an electrically-heated constant-temperature oven.

The door in the background leads into the balance-room, in which are three balances: an Ainsworth pulp-balance, a Heusser automatic, and a Keller button-balance, all placed on a table supported by two concrete piers.

All samples are placed on wooden trays where they are kept until the analyses have been completed. The beakers and flasks, after being washed, are placed on wooden trays of proper size to hold 20 beakers or flasks; these trays when not in use are placed on the shelves beneath the filter-tables. Folding supports are available for holding the trays in the balance-room while samples

are being weighed into the beakers or flasks or other container preparatory to analysis.

Galvanized-iron trays, each of which will hold 30 cups, are used for holding annealing and parting cups.

Wall-plates connected to a 110-volt circuit are available at each filter-table, in the fourth hood, at the general work-table, and at the titrating-tables, so that any special electric lighting or heating device may be attached.

Fig. 3 also shows a convenient arrangement for the sintering of ores in the determination of potash, according to the J. Lawrence Smith method. This equipment is on the general work-table and is not in use constantly, but in no way interferes with the routine work.

A store-room adjacent to the balance-room is conveniently fitted with shelves, drawers, and cupboards. A basement store-room, the entire size of the laboratory, is situated immediately beneath it. The compressed air and vacuum systems are connected to motor-driven air-compressors and vacuum-pumps, which, with the air-receivers and tanks, are also placed in this room.

THE 'ATLAS OF COMMERCIAL GEOLOGY' is a publication under course of preparation by the U. S. Geological Survey. The study of foreign mineral deposits and supplies by the Survey has for years been incidental to the published annual inventory of the mineral production and resources of the United States. During the War, however, this study took on new importance, and work was begun on the study and distribution of the world's reserves of the essential minerals, resulting in the compilation, for the use of the Government, of a world atlas showing the production and resources of the more important mineral commodities. After the data thus compiled had served the immediate confidential needs of the Government itself, the Secretary of the Interior warmly endorsed the proposal to prepare the material for publication, so as to make it useful to the general public. The 'Atlas', the first part of which is now in press, will exhibit graphically the distribution of mineral production and of mineral reserves. An effort is made to give the necessary world view by means of mineral maps of every continent. The basic importance of the raw-material resources to the country makes it a prime public duty of citizens generally to know the facts regarding the mineral industry, and to ascertain these facts the intensive study of our own resources is not enough; we must also acquire a comprehension of what minerals other countries contain to supplement what we have at home. If it were possible to construct a composite diagram showing either the current output or the future reserves of the essential minerals in all the countries of the world the graphic exhibit would show so large a centralization in North America as to suggest that here is a group of nature-favored nations. Yet the present industrial demands for fuels, metals, and other mineral raw materials force the American business man to look beyond the present decade and beyond the borders of the United States.—Annual Report, Director U. S. Geological Survey.

The Combination Method of Mine-Sampling

By MORTON WEBBER

In respect to the 'combination' method of sampling large low-grade ore deposits, devised by me and described in the 'Mining and Scientific Press' of September 27, 1917, I note that several engineers have asked me to enlarge upon some important questions that have arisen from the correspondence on the subject. Before proceeding, I take this opportunity of thanking the following engineers for their contributions on this method of sampling, namely, R. E. Raymond, E. P. Spalding, Charles Bennett, Albert Burch, F. F. Sharpless, L. R. Parsons, H. R. Sleeman, and A. R. Pierce. The subject of mine-sampling is old; and it is, therefore, flattering to have evolved something that may be new and of sufficient importance to merit discussion for over two years.

The discussion had its inception in the discrepancy between the mill-feed and what was expected by sampling the ores of the Alaska Gastineau mine. The discussion brought forth controversy on the merits of hand-sampling versus mill-tests.* The predominance of opinion was in favor of hand-sampling. In this I concurred. I took the view that a mill-test referred only to conditions relatively close to the place from which the results were obtained; that by turning a mill-test of medium size into a big one, if the ore continued to come from the same place, it failed to throw additional light on areas remote from the test, which might be vital to the success of the enterprise.

The mill-test automatically eliminates and discloses the sampling-error, but, as stated, the information is confined largely to the place from which the ore is removed. Hand-sampling, on the other hand, furnishes the mineral content of the deposit over the size of the mass sampled; it contains a latent error (should such be existing), and the mill-feed estimate will be vitiated to this extent.

One of the principal exponents of hand-sampling was L. R. Parsons. He recommended hand-sampling as being infinitely more reliable than mill-tests, and, as I remember it, advocated that hand-sampling about 4 or 5 lb. per foot at close intervals was more reliable than heavy sampling, about 10 lb. per foot, at wider intervals. His intention was to utilize the law of average to a maximum.†

*The term 'mill-test' indicates a metallurgical experiment. Its use in the 'combination' method is not in respect of metallurgy, but of mine-sampling. The term 'bulk sample' is better. The incorrect use of 'mill-test' arose in an early contribution to the subject entitled, 'Mill-Tests v. Hand-Sampling'.

†In conducting a large examination I am in favor of heavy sampling, about 8 or 10 lb. per foot at intervals of 10 ft., against a 4 or 5-lb. sample at 5-ft. intervals. If the mine is 'spotty' and will not stand a 10-ft. unit, then I reduce the unit, but maintain the foot-weight. My reason for this is that the lighter the sample the greater the care that must

I agreed with Mr. Parsons in his desire to utilize the law of averages to a maximum, and I preferred hand-sampling to mill-tests where a choice of only one or the other method had to be made. I took the position that utilizing the law of averages to a maximum extent would, however, fail to disclose a sampling-error latent in the ore. (Close sampling is valuable; in fact, it is necessary in a mine where the value of the ore fluctuates greatly, but it will not detect a latent error, which, when it exists, is latent in each sample without reference to the number taken. Latent errors in sampling can be detected only by actually treating the ore. In the 'Mining Magazine' of February 1915, I contributed an article entitled, 'Latent Errors in Mine-Sampling'. I tabulated various classes of error under the following heads:

(1) Mines where the average metal-value is mechanically reduced, but where the unaccounted metal may be subsequently recovered.

(2) Mines where there exists an unrecoverable loss.

(3) Mines where sampling indicates a fictitiously high value.

(4) Mines where sampling results in an incorrect sub-normal value, conclusive proof being afforded by subsequent commercial results.

(5) Mines where sampling is of no use.

No. 3, 4, and 5 are latent errors. Close sampling in these cases only duplicates or reproduces the error. The other numbers refer to mechanical errors introduced in the removal of the ore. I will endeavor to show that a latent error cannot be estimated, but can only be arrived at by comparison between hand-sampling and mill-feed, whereas a mechanical error can be approximated by the examining engineer, by using the experience obtained in mining similar deposits.

In dealing with latent errors I enlarged upon the subject in the 'Mining Magazine' article as follows: In respect of No. 3, I stated: "Where the metallic contents of ores are in sulphide form the sulphides are frequently more friable than the gangue. In consequence, the samples will contain an abnormal proportion of high-grade 'metallies'. Discrepancies of this class are more usual in copper and other base-metal mines, but in the case of gold and silver ores, where the metal is enclosed in a vehicle of friable sulphide, this error should be very carefully

be exercised in its removal. In the cutting of a light sample there is always the temptation to remove obtruding pieces that come away easily. In small examinations, where the engineer can devote personal attention to cutting samples, light sampling is preferable; but in large examinations I depend on heavy sampling and excite the crews to cut even channels as evidence of their good work. In large examinations, where pneumatic channelers are used, light sampling is impossible, irrespective of its other failings.

considered, as it may result in an estimation out of all proportion to subsequent results."

Enlarging upon No. 4, I stated: "Where there are two sulphides in the same ore, one hard and dense and the other soft and friable, the latter will break more easily in sampling, and will, therefore, be abnormally represented in the valuation. If the major richness is in the hard sulphides the inference is liable to be unfair to the property and the reverse."

Enlarging upon No. 5, I stated: "There is a class of mine where the valuable minerals occur in bunches. Under such conditions no confidence can be placed in an assay-map, even although an unusually close sampling-interval may have been employed. A level on a certain horizon may pierce a certain number of enrichments which would be represented on the sampling record. Had the horizon of the level been, however, 30 ft. higher or lower, the number of enrichments pierced in the latter case would be out of all proportion to the former. In a mine of this type an attempt to sample blocked-out ore would be absurd. The nature of the ore occurrence would demand a veritable network of levels and raises so adjacent to each other that all hope of a commercial undertaking would be obliterated by the development charge per ton. Innumerable cases exist where an assay-plan would show the majority of samples as unprofitable, yet, the commercial result has afforded conclusive proof to the contrary. This class is not composed only of precious-metal mines. The base-metal mines of Missouri and the copper mines of Lake Superior are analogous. The only method of reliable valuation in a deposit of this type would be based on the authentic record of the past yield, in combination with selected representative shipments of the remaining ore."

In view of the foregoing I felt therefore that exponents of either method were in error in the general premise in so definitely taking sides for the mill-test on the one hand or hand-sampling on the other. I advocated that there were advantages in either method, and in order to sample a large low-grade deposit so that the true gross or stoping value of the ore could be estimated, a combination method would have to be employed that would contain the advantages of hand-sampling and also of mill-tests.

At that time I explained a 'combination' method that I had devised for sampling a large low-grade gold deposit in Central America. In this case careful hand-sampling indicated an enormous tonnage of ore that would yield a profit of \$1 per ton. The 'combination' method devised by me, however, disclosed a latent sampling-error of 40 cents per ton. This was 40% of the operating profit as based upon hand-sampling.

The 'combination' method was described in detail in the article from which I have quoted; broadly, it consisted in a large number of small mill-tests spread over the ore deposit; these served to correct the hand-sampling of the spaces intervening between the mill-tests by a factor obtained by successive sampling of the faces of the small stopes as the ore was removed with the recovery

plus tailing loss. The property, therefore, was sampled by hand, but, as stated, each mill-test performed the function of a 'sampling-error indicator' and controlled the hand-sampling of an area or zone surrounding each small mill-test. In this way the entire area was split into mill-test zones. The distance between one mill-test and its neighbor was not uniform. It was controlled by the average of the degree of error between one mill-test and its neighbor; in other words, if there was not a wide discrepancy in the degree of error between one mill-test and its neighbor, the average of the two factors was taken to control the hand-sampling of the intervening space. If there was a wide discrepancy the zone was subdivided by introducing a mill-test in the centre, and so on, until the degree of error became sufficiently uniform to be employed as a factor to correct the sampling by hand.

I emphasize that the size of the area to be controlled by two mill-tests is not governed by the degree of error obtained, but by the fluctuation of the degree. In a contribution by H. R. Sleeman, he indicated that he would advocate the use of the combination method in a case where the mill-test indicated an error up to 8 or 10%. As to this, I believe I have made it clear that the degree of error has little bearing on whether or not the combination method should be employed. What is vital is the uniformity of the error over large areas without reference to how much the error may be. This phase of the subject was ably discussed by R. E. Raymond in his contribution dated November 3, 1917, where he says:

"On thinking over the most practical method of deciding upon the size of the zone I would suggest, if it is intended to put in a 'chain' of mill-tests, that the variation of the sampling-error between one mill-test and its neighbor should be the governing factor on the size of the zone. Whether the sampling-error is large or small should not be a factor in this decision. A mine indicating a fairly uniform sampling-error of 40% could stand much larger zones to each mill-test than a mine where the sampling-error fluctuated from zero to 20%."

In the actual case cited, in Central America, the 'combination' method was successfully employed and prevented a heavy financial loss. The latent sampling-error of 40% was, however, comparatively uniform.

The questions asked by other engineers may be outlined as follows:

A. As the intention is to correct hand-sampling by the factors disclosed by the bulk-sample, would I add a factor to hand-sampling when the bulk-sample showed a greater metal content than indicated by hand-sampling?

B. To describe in detail the means of obtaining the sampling-error from the bulk-sample.

C. A description of the method of arriving at the size of the zone that is to be governed by a mill-test.

D. Would not the application of this method to mines containing secondary enrichment be attended with unusual difficulty?

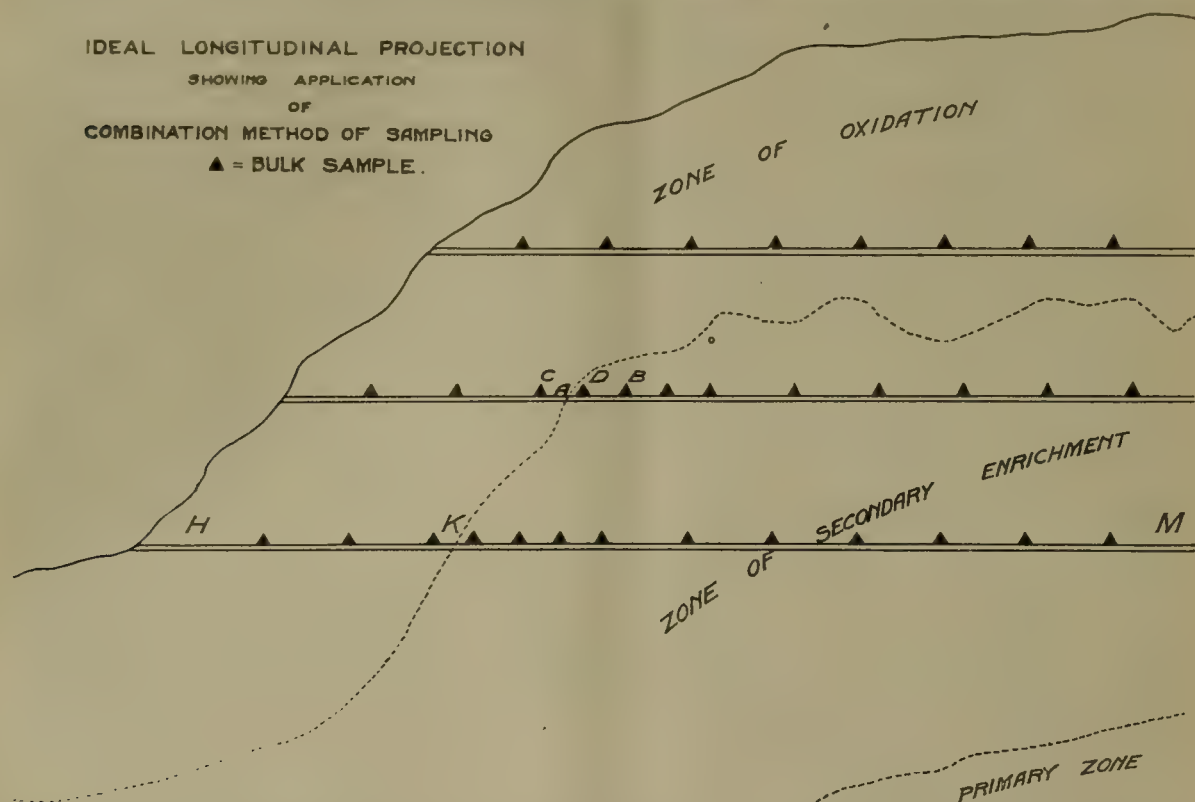
Answering question A: I have examined mines that milled or shipped better than hand-sampling would in-

dient. I believe I have answered this question in my reference to my old article on latent errors that appeared in the *Mining Magazine*, under tabulations No. 4 and 5.

In answering question *B*: As to how to obtain the sampling factor from the bulk-test, I will describe how this was done in the actual case in Central America. The width of the vein was about 30 ft. Holes one foot deep were put in the back of the levels about 18 in. apart, in five rows from wall to wall about 2½ ft. apart. Before the holes were drilled, five channels were cut from wall to wall 2½ ft. between each channel. After the round was fired, five new channels were sampled, when another

stope should not be less than one-third the width of the vein. This relation of the quantity stoped to the width of the vein should not be taken as a ratio to be applied to narrower veins and generally dissimilar deposits.

Two features may be mentioned as having been disclosed by this experience: (1) That it was found unnecessary to make 50 separate assays to represent the hand-sampling of the stope. It was found, by carefully mixing and cutting down the samples from each channel by means of a Jones sampler to pulps of similar weight, that the assay of the resulting pulp was sufficiently close for practical purposes to the average of 50 separate



series of one-foot holes was put in, and so on. In this way a small stope was carried up for the entire width of the vein. Care was taken not to drill the holes more than one foot deep, because it was important to have as many hand-samples from the re-channeling of the back of the stope as possible. The law of averages was employed to a maximum by this means; namely, five separate channels 2½ ft. apart cut after every round which broke not more than one foot in vertical height. The back of the stope was carried up about 10 ft. In this way about 200 tons of ore was obtained, which was represented by 50 assay-pulps. The difference between the average of the 50 assays and the mill-recovery, plus tailing loss, gave the sampling-error. If the vein had been narrower, a smaller mill-test would have been employed. After the sampling-error is obtained, there is little gain in continuing to stope more ore from the same place. I felt in the case under review that the length and height of the mill-test

assays. If this 'short cut', however, is employed it is absolutely necessary that the sampling crew must be sufficiently skilled in cutting down to finish with pulps of similar weight. (2) If I were to sample another large low-grade ore deposit, I would not use a mill to obtain the mill-test. The same result can be obtained by employing a bulk-sampler, as used at smelters. In the Central American case I had to use the equipment at my disposal, namely, a small mill; and in order to get the mill-feed it was necessary to add the recovery to the tailing loss, the sum of which is automatically and more accurately obtained by a bulk-sampler.

In respect to questions *C* and *D*, dealing with the means of determining the size of a mill-test zone and the influence of secondary enrichment in the application of this method of sampling, I will submit an ideal longitudinal projection. Mr. Sleeman referred to the influence of secondary enrichment. While I do not see a fundamental

reason why secondary enrichment should vitiate this method of sampling, I will, however, state that this method was originally devised for sampling low-grade gold deposits. In my experience I have not met with any examples of secondary enrichment in gold deposits; and I doubt if they exist. There are a large number of gold deposits that owe their profitable nature to differential enrichment, but not to secondary enrichment. The latter is the migration and re-precipitation of sulphides on a metal base. Differential enrichment as found in gold mines is the leaching out of solubles, leaving the original metallic content differentially enriched.*

In dealing, however, with copper or other base-metal cases, where true secondary enrichment is in existence as represented by the diagram of the ideal case, it will be noted that the fluctuation in the sampling-error would adjust itself automatically. On level No. 1, it is assumed that because secondary enrichment is below this level there is a uniform degree of error, and therefore the mill-tests are put in at regular intervals, the value of the ore-body being obtained by hand-sampling, corrected by the average of the error obtained by the mill-tests. On level No. 2, secondary enrichment begins to appear at the point A. The mill-test put in at B, the usual unit distance from mill-test C, discloses a wide fluctuation in the degree of error, with the result that the distance is split in two, and mill-test D is made. While a large fluctuation may be observed between D and C, it is reasonable to expect that D and B will be more or less the same, as the ore is obtained in both cases from the secondary zone. If, however, a considerable discrepancy should exist, there is no reason why the distance should not be subdivided. The same method could be pursued on the third level where it intersects the sulphide zone.

This diagram should illustrate the point made by me in my former writing on the subject, that the 'combination' method is not dependent, as Mr. Sleeman claims, on the smallness of the sampling-error, but on the uniformity of the degree of sampling-error. If the average of the error from H to K was 5%, but comparatively uniform between mill-tests, say, 300 to 400 ft. apart, I claim that an error so obtained could be safely used to correct hand-sampling over this distance. If the error K to M was found to average 30% or more, as long as the error in the secondary zone did not fluctuate sufficiently from place to place to require mill-tests at such close intervals, as would make the method of sampling financially prohibitive, then there is no reason why the error obtained by the mill-tests should not control the hand-sampling between K and M. As long as H to K has a uniform error and K to M has a uniform error, I see no reason why the 'combination' method should not be successfully applied to base-metal deposits as well as gold deposits.

Mr. Raymond stated that, had the 'combination' method

been applied to the Alaska-Gastineau the loss of about \$15,000,000 would have been prevented. I note that Mr. Pierce states that at all events a large part of the loss would have been saved. As to this, I cannot say. I would make myself ridiculous if I made such a statement about a property with which I am not thoroughly familiar. I have, however, used the 'combination' method in the actual case presented, and thereby avoided a heavy financial loss. I am also familiar with other important mining enterprises where this method could have been successfully applied. As we grow older we realize it is upon the 'honest failures' of ourselves and compeers that a large part of progress is based.

WULFENITE is one of the two ores of molybdenum found in commercial deposits in the United States. The other, molybdenite occurs more frequently and for that reason has been given greater consideration by those working on methods of treatment. J. P. Bonardi has, however, done some experimental work, the outcome of which he summarizes as follows: The results found with the experimental Wilfley table indicate that wulfenite can be concentrated from a barite gangue with very promising results, since on the small laboratory machine used, a recovery of between 60 and 70% of the molybdenum could be effected by passing the material only once over the table. It must be remembered also that a recovery had previously been made on the original milled ore of over 60%, so that the additional increase obtained from the middling material, when ground through 80-mesh and with no further classification, gives a total recovery of over 85%. This recovery on material that had received no special classification, outside of grinding, emphasizes further the adaptability of wet concentration methods to wulfenite ores, even with such high specific gravity gangue as barite. By a slight rearrangement of the mill circuit, wulfenite should be as readily separated from barite as from gangues of a lower specific gravity.

PHOSPHATE DEPOSITS have been discovered in the eastern part of Holland, at a place called Ootmarsum, in the Twente district. About 30 tons of 15 to 20% phosphate is being produced each day, and is being sold locally at prices corresponding to the prices of imported phosphate. The stratum ranges from 7 in. to 3 ft. in thickness, but on account of the fact that it is not continuous the work of extracting the rock is very expensive. In some places the stratum is on the surface; in others it is as much as 25 ft. beneath the surface.

A \$15,000,000 national mining corporation has just been formed by the leading British mining finance companies, in co-operation with British capital, to develop mining properties on a large scale in different parts of the world, says a recent bulletin of the American Chamber of Commerce in London. The new corporation is expected to be a British parallel of such American organizations as the American Smelting & Refining Co. and the United States Metals Co.

*While it is not in direct line to this subject, it may be well to mention that a large number of gold mines owe their origin to differential enrichment and the falling off in gold content on leaving the superficial hydrated surface is responsible for the huge mortality of gold deposits in depth.

Valuation of Oil Properties for Federal Taxation

The Price of Californian Crude Oil After March 1, 1913, to be Used in Valuing Oil Properties as of That Date

INTRODUCTION. A committee, representing a number of the larger oil companies in California, met in San Francisco on November 12, 1919, for the purpose of discussing the depletion deductions to be allowed in computing the Federal income-taxes under the Internal Revenue Act of 1918. It was the general sense of the committee that a system based on sound engineering principles should be formulated for estimating the value of oil properties, so that better and more uniform results might be obtained by the various companies in filing their returns with the Bureau of Internal Revenue. A sub-committee consisting of five petroleum engineers was thereupon appointed to collect information and draft a report; the committee consisted of G. C. Gester, Carl H. Beal, J. H. G. Wolf, E. G. Gaylord, and E. D. Nolan. This report is the work of that committee.

GENERAL STATEMENT OF PROBLEM. The recent manual of the Treasury Department compiled for the administration of the income and excess-profits tax-laws for 1918 gives the method of estimating future oil-reserves by the latest engineering principles, but no definite method was established for fixing the value of the oil in the lands in question, except that the value should be as of March 1, 1913. It seems to have been assumed that the value of oil-lands would be fixed by sales in the open market of similar and adjoining properties. This method is absolutely useless in the Californian oil-fields for three reasons:

(1) Sale-prices, to be of any value, according to the Treasury Department, must represent transactions between "a willing buyer and a free seller". This condition could not be fulfilled in 1913, because of the great depression, which resulted in 'forced' sales only, and

(2) Sales of large and successful properties were and are rare, and

(3) The productiveness of adjoining tracts varies so greatly that the selling-price of one tract can be equitably applied only with great difficulty as the standard of value for another tract.

In addition, production seemed to have nearly reached its maximum, while the demand was steadily increasing, so that obviously a higher price would prevail in the future. Therefore, if, for the March 1, 1913, valuation for the price at that time were used for applying to future production, improper results would be obtained.

PRESENT-VALUE METHOD. The present-value method for estimating the value of oil-lands and mining properties in general, is recognized as the latest and soundest engineering method of appraising such properties. It

has been thoroughly discussed by Herbert C. Hoover in 'Principles of Mining' and by John R. Finlay in the 'Cost of Mining'. There is every reason to believe that the Treasury Department will accept values of oil-lands as fixed by this method, provided sufficient data are at hand to determine the essential factors with reasonable trustworthiness.

L. C. Graton, Valuation Engineer of the Internal Revenue Department, in an article entitled 'Federal Taxation of Mines' in the November bulletin of the American Institute of Mining & Metallurgical Engineers,* discusses this problem, and shows this to be the generally accepted method among engineers for arriving at the value of mines, and, likewise, of oil properties. This method is also the method recommended to the Treasury Department in a report prepared in October 1919 by a committee of mining engineers, representing the American Institute of Mining & Metallurgical Engineers, who had been in convention in Chicago in September 1919, and who were invited to Washington by officials of the Treasury Department to draw up suggestions for re-writing the departmental regulations governing the application of the income-tax law to the mining industry.

The essential factor to be determined, in applying the present-value method, is the future selling-price of the oil, and it is with this factor in determining oil-land values that the following report deals. Mr. Graton emphasizes the fact that all available data should be used in determining the future selling-price; he states "that the trend in such cases, rather than the average, is important. Yet it must be ascertained if the trend is in itself but a part of a minor fluctuation; that is, the component of a greater trend."

GENERAL CONDITION OF THE OIL INDUSTRY IN 1913. Production in California in 1913 had been rapidly increasing for several years, but evidence was at hand to show that this production was about to reach its apex and would, thereafter, begin to decline. The statistics available, to one making estimates of value as of March 1, 1913, would indicate that consumption during several years prior to 1913 was gradually approaching production, and in all probability, stocks must soon thereafter be drawn upon, in order to supply the demand if the same rate of consumption continued.

Several authorities may be quoted in support of the above statement. Mark L. Requa, late oil administrator

*See also 'M. & S. P.', October 11 and 18, 1919.

for the Federal Government, in an address delivered before the Mining Association, University of California, Berkeley, in November 1912, on the 'Oil Resources of California', said:

"It is not possible that this increase can continue in any such ratio over any long period. There is reason to believe that California can find a market for 80,000,000 bbl. annually within two years and 100,000,000 bbl. within five years."

Ralph Arnold, late chief of the oil and gas section, Bureau of Internal Revenue, made the following statement in the bulletin of the American Institute of Mining Engineers, of March 1914:

"As a concluding statement concerning production, it is the senior author's belief that the total yield of California for any one year will never go much, if any, over 100,000,000 bbl. and that the time will come within the next year or two when the maximum production will be reached, after which the curve of production will be a descending one. Such has been the history of all of the older fields in this country and such is the logical result to be expected in California. With the increasing uses and markets for oil resulting in a constantly increasing consumption, it is obvious that the price of oil will go up rapidly the minute the general public realizes that the reserves are being drawn upon to meet the demand."

MARKET. The Californian oil-fields supply a region that forms an economic province within itself, because it is far removed from any other competing oil-fields. The scope of its market includes all of the Pacific Coast of North and South America, the Hawaiian Islands, China, and Japan. This whole region was rapidly developing prior to and during the year 1913, and the Pacific Coast section of the United States was growing more rapidly in population and the industries were expanding much more rapidly than the remainder of the United States. Furthermore, this region is marked by the scarcity of its coal resources, and the growing industries were and are largely dependent upon Californian oil for their supply of fuel.

Mr. Requa stated in November, 1912, in regard to this market:

"With the completion of the Panama Canal, provided a satisfactory supply can be obtained on the Atlantic seaboard which there is reason to believe is not improbable, steamers between New York and San Francisco and possibly European ports will use oil as fuel. The present market comprehends a territory from Alaska to Chile and inland as far east as Carlin (Nevada), El Paso (Texas), and Albuquerque (New Mexico). Within this area there is yet much room for expansion and if we add to this the possibilities open to this by the completion of the Panama Canal, we have a market of enormous potentialities."

David T. Day, of the U. S. Geological Survey, emphasizes the importance of petroleum to the Pacific Coast in the 'Production of Petroleum in 1912', as follows:

"The production of California will undoubtedly become a more significant element in the general petroleum industry with the opening of the Panama Canal until at least the consumption in California outstrips production. It is not improbable that the flow of fuel-oil through the pipe-line alongside the Panama Canal may eventually

be reversed because fuel-oil is essential to the industrial development of the West Coast."

The above statements show conclusively that the enormous possibilities of the market for Californian oil and the necessity of the supply of fuel-oil on the Pacific Coast were clearly recognized in 1912 and 1913.

TREND OF FUTURE PRICE. The price of any mineral is limited on the one side by the lowest cost of production of any operating property, and on the other side by the cost of competitive materials. If no oil can be produced at a profit very soon none will be mined. In the year 1913 oil was selling at a base price of 35c. per barrel in California. At that time, the cost of production from numerous properties was at least this much per barrel and possibly more. It is evident that prices in 1913 were at a minimum as a result of flush production, which began with the year 1910 in the Midway field. The only possible change in prices would necessarily be upward.

The other limit, providing the market could be expanded sufficiently to absorb production, and this we have already shown was quite probable, would be the cost of competitive materials. We have already commented on the scarcity of coal on the Pacific Coast.

In November, 1912, Mr. Requa made the following comment on the coal situation in California:

"The west coast of North America, Central and South America, is poorly supplied with coal deposits. Aside from the deposits in Washington, British Columbia, and undeveloped resources of Alaska and Peru, there is no available fuel of satisfactory quality. The coal that is produced does not compare with the best Eastern, Welsh, or Australian coals and the cost is materially higher. Herein lies the reason of the great success of and the demand for Californian oil."

In the same address, Mr. Requa gives the fuel-ratio between steam-coal and Californian oil as one ton of coal to three and one-half barrels of oil.

In 1913 steam-coal in shipload lots sold for \$7 per ton in San Francisco. This would indicate a value of \$2 per barrel for Californian oil for fuel purposes only.

In bulletin No. 365 of the U. S. Geological Survey, the fuel-ratio between the coal of Puget Sound, which is the source of the greatest amount of coal used on the Pacific Coast, is given as one ton of coal to three barrels of oil. This ratio indicates a value of \$2.33 per barrel for Californian oil.

Emphasis must be put on the fuel-value of oil because the bulk of the Californian production is fuel stock. Quoting again from Mr. Requa, he makes the statement that fuel consumption of the Pacific Coast had increased 70% over a five-year period preceding, but coal consumption had remained approximately the same.

In Bulletin 69 of the California State Mining Bureau, written in 1914, there is the following statement:

"The maximum price at which oil can sell is not so easily determined as there are many influences bearing upon it. In general, fuel-oil cannot sell for a greater price than that at which the consumer can profit by turning to some other source of power, such as coal, electricity, or wood. An instance, merely for an illustration as the figures may not be exact, is that the maximum cost

at San Francisco could not be greater than that of coal which has usually sold wholesale for from \$6 to \$8 per ton, but has been estimated as possible at \$3.50. Tests have shown three and one-half barrels of oil to be equal in heating-value to a ton of coal. Therefore, the maximum price of fuel-oil at San Francisco should be about \$1, or possibly \$2, depending on the price of coal. As a matter of fact, it has usually sold at from 60 to 70 cents."

W. W. Orcutt, chief geologist for the Union Oil Co., in a private report dated April 20, 1912, stated:

"The demand for Californian oil can be enlarged to almost any reasonable amount by extending its markets. The actual consumption of Californian crude oil increased tenfold during the period of 1900 to 1910. This was due very largely to increased consumption in the Pacific Coast States. This local market is still growing rapidly, owing to the great development of the West. There are also extensive markets in Hawaii, Japan, Alaska, and South America, and the completion of the Panama Canal will open the markets of the Eastern United States and Europe. At the Canal the paths of the merchant marine of the world will converge, and there it will 'fuel-oil' its ships. Oil and transportation only are necessary to be able to supply these markets. At its present rate of consumption, California has a supply of crude oil sufficient to last 50 years. The industry does not now have enough transportation, but it can and will be supplied. When this is done the field of consumption will be enlarged and the demand for oil will be increased; therefore, the market-price must advance. In comparison with coal, fuel-oil should be worth \$1 per barrel at the wells of production within the next few years, and for refining oils a still higher price will, in all probability, obtain for the same period.

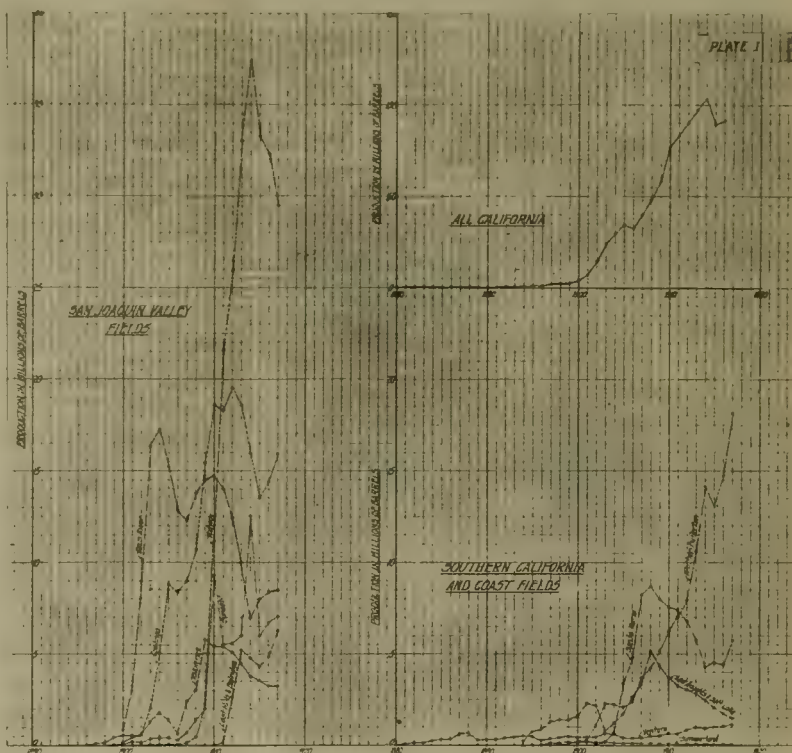
"The average price figured in the following estimate of production, receipts, and expenditures, is from 50 to 75 cents per barrel, but I believe that the average price that will actually be received for the next twenty or twenty-five years will be much higher."

The value of Californian oil in fuel alone represented at least \$2 per barrel in 1913 and it was the opinion of the leading operators and petroleum engineers that the price of oil would soon rise to a much higher figure than that obtained in 1913, both on account of the large undeveloped market and the necessity of oil for fuel.

Regard must also be taken of the fact, as the records show, that when once the price turns upward the trend is not checked until the conditions that brought about the movement change; so long as demand exceeds supply the price current is upward. The records show that it is not sufficient merely for the supply to equal the demand, it must exceed demand before the trend is halted. This is

because at no time in history has the market failed to absorb new production when once the facilities for distribution were established. Crude petroleum as a commodity differs in this way from almost every other staple of commerce; its position in industry and economies is therefore individual, and its problems must be so treated. The substance is unregenerative in nature, hence the quantity available is fixed, while the demand may be practically unlimited.

CALIFORNIAN PRODUCTION NEAR ITS APEX. A detailed study has been made of the entire production of the various fields in California. Curves of the production of these fields are shown on Plate I. From these curves it is evident that the production in all but two of the fields in



California had already reached its peak and was on a permanent decline. The two fields that were as yet increasing in their production were the Midway and the Whittier-Fullerton.

The daily output per well in the Midway field began to decline in the spring of 1911, but the total production continued to increase because of the great number of wells that were constantly being drilled. With a rapid decline in the average production per well per day, it may therefore be concluded that while the crest of production in the Midway field had not been reached in 1913, the peak production of the field would be reached within a short time.

The Whittier-Fullerton field was still increasing in production and the average production per well per day was also increasing. It was therefore logical to assume

that the crest of the production in that field was indefinite. In the year 1913 the Whittier-Fullerton field did not bear the relative importance to the total production of California that it now does, and there was no reason to believe that its increase would make up for the declines of all the remaining fields, and an engineer at that date would be justified in assuming that the Californian production was about to pass its crest and start on a decline.

Mr. Arnold has stated that 100,000,000 bbl. would be the approximate maximum production obtained in any one year in the State of California.†

CONSUMPTION APPROACHING PRODUCTION. Statistics of the Government bureaus show that several years prior to 1912 a considerable gap existed between consumption and production, and that at the beginning of 1912 production still exceeded consumption by a considerable margin. The excess, however, diminished rapidly during that year and at the beginning of 1913 consumption practically equalled production. On March 1, 1913, there was so little difference between consumption and production that the field-price of crude oil increased five cents per barrel. In the fall of 1913, consumption exceeded production.

Even though it is not established that production in California had reached its apex in 1913, the rise in price in the future would be as certain, provided consumption exceeded production.

The Standard Oil bulletin in June, 1914, stated as follows:

"From 1901 to 1906 there was a constant over-supply and the average prices consistently dropped. From 1906 to 1909 storage was reduced, the reduction reflecting an increased demand, and values moved up correspondingly. Nineteen-ten was a gusher period in the Midway district and storage increased rapidly accompanied by decreased prices. This condition continued until 1912, when the demand had substantially approached the supply and the price had again started on an upward trend."

It must be remembered that at the beginning of 1913 no engineer could have foretold the depression that was to come in 1915 as a result of the world war.

An article in the 'Mining and Scientific Press' for October 11, 1913, is worthy of consideration.‡ Curves are therein presented to show the rate at which consumption was approaching production during the years 1911 and 1912. These curves show consumption equaling production during the first part of 1913. When consumption equalled and threatened to exceed production, stock would have to be drawn upon to meet the demand. The law of supply and demand would then necessitate an increase in the price of crude oil. Furthermore, as the production of crude oil was approaching its peak and as the markets for crude oil from this State were rapidly increasing, then in the year 1913 an engineer would be justified in believing that future years would see a constantly increasing price for oil.

PETROLEUM RESOURCES. Petroleum is unregenerated in nature and the supplies of it are therefore limited and exhaustible. It was recognized by leading engineers long before 1913 that the resources of California were limited. Mr. Requa, in the paper already quoted, discusses the future production of the State and makes the statement that no important extensions of the present fields may be expected north of Coalinga or south of Fullerton.

Dr. Day, in bulletin No. 394 of the U. S. Geological Survey, shows that California was believed to be the only State on the Pacific Coast that possessed commercial deposits of petroleum.

Both Mr. Arnold and Dr. Day made estimates of the probable future production of petroleum in California. The former's estimate, made in 1908, gave a minimum of 5,000,000,000 and a maximum of 8,500,000,000 bbl. Mr. Arnold estimated in 1915 that only 2,300,000,000 bbl. of extractable oil remained in the ground. This, when compared with the annual production of approximately 100,000,000 bbl., is deeply significant.

As it was recognized that the resources of petroleum on this Coast were comparatively limited and exhaustible, and as petroleum is absolutely necessary to modern civilization, it follows that all land from which oil might be extracted at any time in the future, had a potential or prospective value in 1913.

SUMMARY. Conditions in California, affecting the future price of oil, of which an engineer might have been expected to have knowledge in 1913, may be summarized as follows:

California controlled a region that was an economic province in itself, consisting of all the territory contiguous to the Pacific Ocean. It was a region that was rapidly expanding, and in which many new industries, largely dependent upon the oil for their fuel-supply, were being developed.

The period immediately preceding 1913 was one of flush production, with a rapid increase in the total production of the State.

The selling-price of oil in 1913 was below the average cost of production, and therefore, represented a minimum price. The price of coal, which was the chief competitor of Californian oil, would indicate a value of at least \$2 per barrel for oil in San Francisco.

The study of the production from the various fields in the State would indicate that the production of the State was nearing its apex. This, also, was the opinion of leading engineers including Mr. Arnold, late head of the oil and gas section, U. S. Bureau of Internal Revenue.

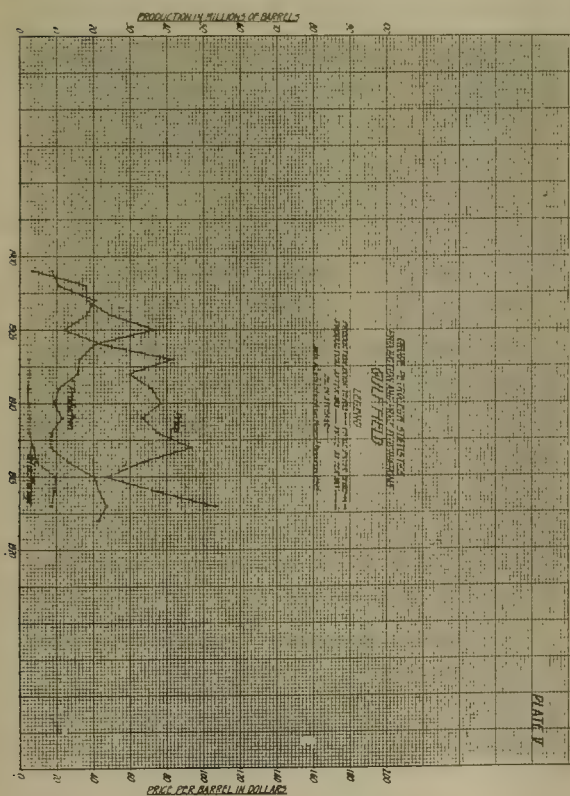
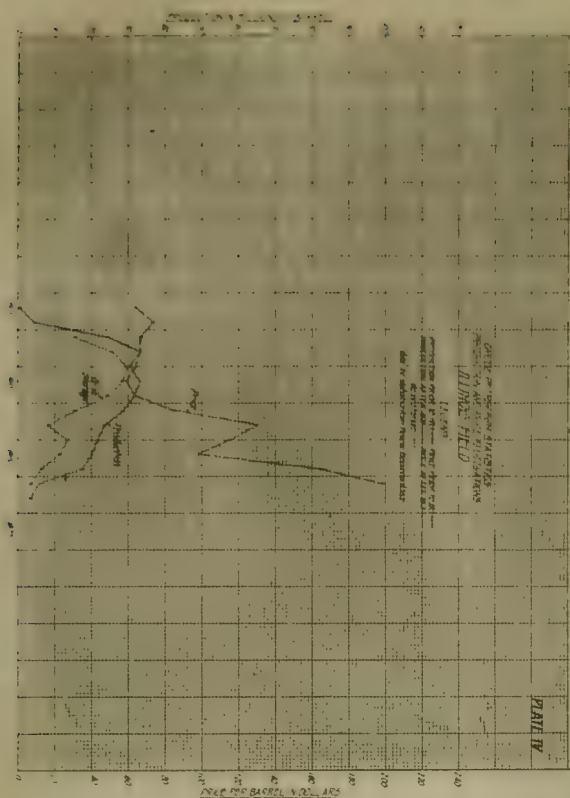
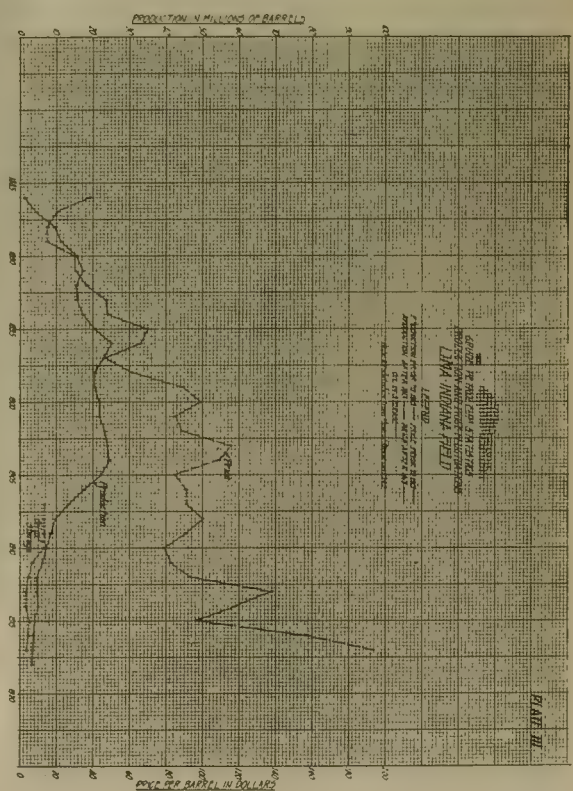
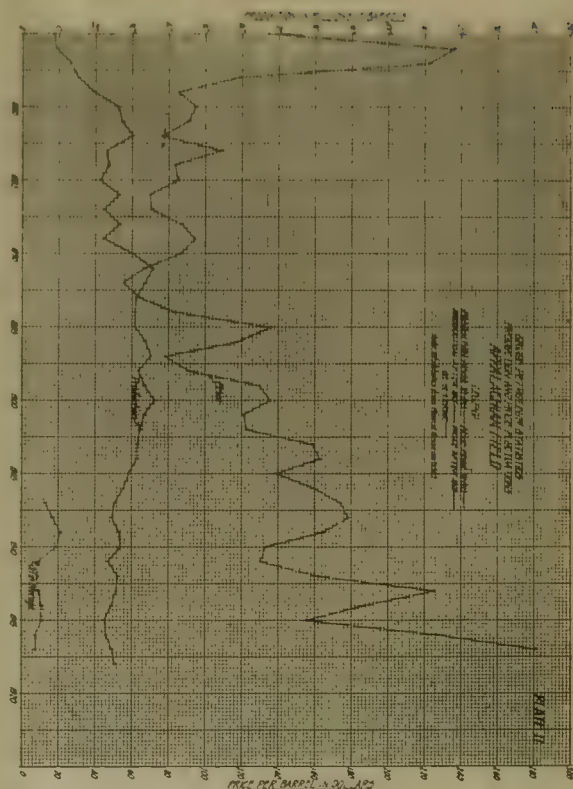
The proportion of high-grade refining oil was steadily increasing and this would in itself indicate a greater value for the State's production in the future.

Consumption, which had lagged behind production for several years prior to 1913, approached, and even exceeded, production during that year. There was every indication that stocks would shortly have to be drawn upon to a considerable extent to meet the increasing demand.

In view of the above facts it seems logical to assume

†'Geology and Technology of California Oil-Fields', Ralph Arnold and V. R. Garfias, A. I. M. E., March 1914.

‡'California Oil Production for 1913', by J. H. G. Wolf.



that an engineer with the viewpoint of 1913 would expect an ever-increasing price of oil in the future.

FORECAST FROM RESULTS IN OTHER FIELDS. The preceding argument establishes the fact that a rise in the price of oil after March 1, 1913, was imminent; we now turn to the history of price and production in other fields of the United States for confirmatory evidence.

The real problem was to forecast in a rational way, and in accordance with engineering and economic principles, what this expected increase might be from year to year in the future. A study was made of the results of the law of supply and demand in other important oil-fields of the United States where the course of free prices over a number of years was available from Government statistics.

The annual production and average annual price from the following major fields in the United States were plotted from data published by the U. S. Geological Survey for as many years as it was possible to obtain information:

1. Appalachian field, comprising south-western New York, western Pennsylvania, north-western West Virginia, and south-eastern Ohio (Plate II).

2. Lima-Indiana field, comprising western Ohio and eastern Indiana (Plate III).

3. Illinois field, lying in the south-eastern part of Illinois (Plate IV).

4. Gulf Coast field, lying in the Gulf coastal plain (Plate V).

The Appalachian curves (Plate II) show that the peak of production, which corresponds closely to the time that prices began to increase, was in 1891. The trend in prices from that time onward was consistently upward. An average line was drawn through the price-curve showing the upward trend of prices as far as the year 1912, no subsequent information being used. The average annual percentage of increase in price was then computed. The same statistics were determined from the price-curves representing the remaining major fields. The results from the four fields may be tabulated as follows:

Field	Average annual increase in price, %	Years over which price increase was computed
Appalachian	11.3	1891-1912
Lima-Indiana	9.8	1906-1912
Illinois	20.9	1910-1912
Gulf Coast	7.4	1903-1912

It is to be regretted that statistics giving shipments or consumption were not available. Although it follows necessarily that when production started permanently to decline, the consumption caught up with the production and soon exceeded it, the curves showing the actual consumption would bring out more clearly the action of the law of supply and demand.

Storage statistics are available from 'Mineral Resources' for the year 1907 onward, and these have been plotted on the several curves. They serve as excellent substitutes for the consumption curves, because they indicate clearly the time when consumption exceeded production and it was necessary to draw upon stored oil to meet the demand. It will be noted that the price began

to rise immediately, and the trend, in general, was upward for the remainder of the life of the field.

CONCLUSIONS. A full consideration of all the evidence available, both as to the general conditions in California and the history of the price and production statistics of the older oil-fields of the United States, warrants the following conclusions:

1. The rate of increase in the price of crude oil at the well prior to the year 1913 for four major fields in the United States, when once consumption passed production, was found to average about 12.3%. The certainty with which the course of prices changed definitely upward the moment consumption passed production gives to this fact a weight and importance approaching that of a fundamental principle of the oil industry, and proves the inexorable working of the law of supply and demand.

2. Consumption in California had equalled production in the latter part of 1912; and petroleum engineers and operators generally were expecting an increase in the price of oil in the immediate future.

3. Industries were expanding in the territories dependent upon California for their supply of oil more rapidly than in the four fields that furnished our precedent for determining the probable course of prices. Foreign markets in South America, Asia, the Hawaiian Islands, and the domestic Coast were opening and becoming absolutely dependent upon the Californian crude oil as their source of fuel.

4. After considering the facts as nearly as possible from the 1913 viewpoint and taking into consideration the opinions expressed publicly and privately at that time by petroleum engineers and operators, we are convinced that the price of Californian oil from 1913 onward could reasonably have been expected to increase consistently, for the supply had already been equalled by the demand. Because of the relationship between supply and demand at that time, prices could have been expected to increase at least as rapidly, and very likely more rapidly, than they had in other fields in previous years. In fact, the price increase could have been expected to be as rapid as that for Illinois (about 21%), for this State had to depend absolutely on its own supply, whereas Illinois lies within the markets of other large and only partly exhausted fields.

5. The schedule of prices in the accompanying table is therefore proposed for adoption by engineers and oil companies in making appraisals of oil properties as of March 1, 1913. The principle involved should be applied likewise to appraisals made as of any date subsequent to March 1, 1913. The prices after 1913 are based on an average annual increase of 15% of the base price paid on March 1, 1913, with the exception of 14°B. to 21°B. oil from the San Joaquin valley, no increase being given for 1913. An average annual increase of 17% was used for these grades as produced in the San Joaquin valley, because of the difference in the 1913 price paid for these oils and those of the next higher gravities, namely, 35c. for the fuel grades and 50c. per barrel for

the oil between 21°B. and 23.9°B. To increase the price of the former at the same rate as that of the latter would make an improper and unjustified difference in the prices to be received for those grades in subsequent years. The greater rate of increase for the fuel grade is further justified by the fact that the stocks of fuel-oil were decreasing at this time in spite of material additions to the supply by the residuums of the refining grade. The following table and statement, published in the Standard Oil bulletin of June 1914, shows this decrease nicely:

Six months ending	Under 20°B.	Over 20°B.	Total
December 31, 1911	28,052,191	15,325,631	43,377,822
June 30, 1912	26,437,746	17,233,000	43,670,746
December 31, 1912	25,500,054	20,875,743	46,375,797
June 30, 1913	25,070,035	22,151,801	47,221,836
December 31, 1913	23,602,839	27,042,509	50,645,348

"It will be seen that from the end of 1911 to the end of 1913 the fuel-oil for a six months period declined 4,450,000 bbl. while the production of light refinable crudes increased 11,700,000 bbl. It may be said further that the average gravity of the light crudes two years ago was but little higher than 21° gravity, while the gravity is now above 25°. The figures here offered should suffice to show that the economic law of supply and demand is the certain and immutable factor in the regulation of prices."

That the proposed prices are reasonable and conservative may easily be seen by referring to the actual price of crude oil in California today. For instance, in the table, the price in 1919 for the fuel grade is 70c., whereas that actually paid is \$1.23 per barrel at the well, and this price prevailed as early as May 1918. It should be remembered that these prices are those that we feel could reasonably have been expected by oil-operators and appraisers on March 1, 1913. The European war and the resulting extraordinary stimulation in the demand for, and price of, petroleum could not have been foreseen by anyone. Furthermore, no one knew at that time that the purchasing power of the dollar, as compared with the pre-war period, would decline to approximately 60c., and that all commodities, as a result, would have increased greatly in price.

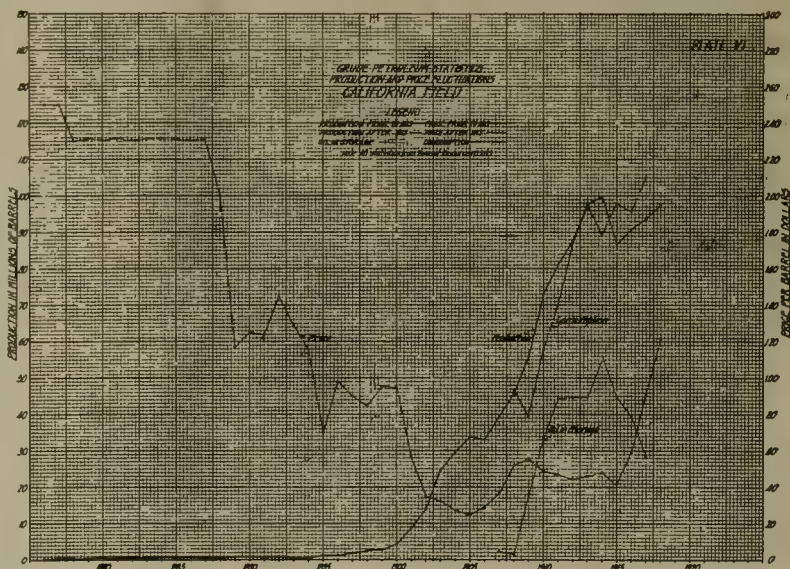
It will be noted that no price has been estimated for years subsequent to 1924. These estimates have been omitted only because of expedience. In our opinion, appraisers, in estimating the price of oil after 1924 should retain the same percentages upon which the table is based, that is, an average annual increase of 17% over the 1913 base price for fuel-oil, and 15% over the base price paid in 1913 for the oils of higher gravity. This rate of increase is regarded as the minimum, and should be retained up to the point when the price will be affected by the importation of fuel-oil from Mexico and by the use of hydro-electric power and of coal. Although no

Table Showing Market Price for Different Grades of Crude Oil at the Well in California on March 1, 1913, and the Prices that Reasonably Might Have Been Expected for the Same Grades of Oil in Eleven Subsequent Years.

		San Joaquin Valley Fields (price in cents)															
Grade, deg.		14	18	19	20	21	22	23	24	25	26	27	28				
Bar. Baume		17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0				
Mch. 1, 1913.	Price	35	35	35	35	50	50	50	55	55	55	60	60				
1914.		41	41	41	41	57	57	57	63	63	63	69	69				
1915.		47	47	47	47	65	65	65	71	71	71	78	78				
1916.		53	53	53	53	72	72	72	80	80	80	87	87				
1917.		59	59	59	59	80	80	80	88	88	88	96	96				
1918.		64	64	64	64	87	87	87	96	96	96	105	105				
1919.		70	70	70	70	95	95	95	104	104	104	114	114				
1920.		76	76	76	76	102	102	102	113	113	113	123	123				
1921.		82	82	82	82	110	110	110	121	121	121	132	132				
1922.		88	88	88	88	117	117	117	129	129	129	141	141				
1923.		94	94	94	94	125	125	125	137	137	137	150	150				
1924.		100	100	100	100	132	132	132	146	146	146	159	159				

		Ventura County															
Mch. 1, 1913.	Price	45	45	45	50	55	70	70	80	80	80	90	90				
1914.		52	52	52	57	63	80	80	92	92	92	103	103				
1915.		58	58	58	65	71	91	91	104	104	104	117	117				
1916.		65	65	65	72	80	101	101	116	116	116	130	130				
1917.		72	72	72	80	88	112	112	128	128	128	144	144				
1918.		79	79	79	87	96	122	122	140	140	140	157	157				
1919.		85	85	85	95	104	133	133	152	152	152	171	171				
1920.		92	92	92	102	113	143	143	164	164	164	184	184				
1921.		99	99	99	110	121	154	154	176	176	176	198	198				
1922.		106	106	106	117	129	164	164	188	188	188	211	211				
1923.		112	112	112	125	137	175	175	200	200	200	225	225				
1924.		119	119	119	132	146	185	185	212	212	212	238	238				

		Whittier-Fullerton															
Mch. 1, 1913.	Price	65	65	65	65	70	70	70	80	80	80	90	90				
1914.		75	75	75	75	80	80	80	92	92	92	103	103				
1915.		84	84	84	84	91	91	91	104	104	104	117	117				
1916.		94	94	94	94	101	101	101	116	116	116	130	130				
1917.		104	104	104	104	112	112	112	128	128	128	144	144				
1918.		114	114	114	114	122	122	122	140	140	140	157	157				
1919.		123	123	123	123	133	133	133	152	152	152	171	171				
1920.		133	133	133	133	143	143	143	164	164	164	184	184				
1921.		143	143	143	143	154	154	154	176	176	176	198	198				
1922.		153	153	153	153	164	164	164	188	188	188	211	211				
1923.		162	162	162	162	175	175	175	200	200	200	225	225				
1924.		172	172	172	172	185	185	185	212	212	212	238	238				



evidence is available that will indicate at just what time in the price-course these three sources of power will affect the price of oil, nevertheless, it is certain that at some time in the future these three elements will gradually have their effect upon the rate at which the price of fuel-oil will advance. This rate of increase will gradually decrease until a balance has been struck. The upper limit of the price of fuel-oil has been taken at \$2.50; \$2

per barrel at the well has been taken as the price when these three elements will begin to affect price history. It is therefore recommended that a 17% average annual increase be used for fuel-oil until it has reached the price of \$2 per barrel, and that thereafter the annual increase will be 16%, 15%, 14%, 13%, 12%, 11%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, and 1%.

In the case of the refining-oil, \$4.50 has been assumed as the upper limit, but \$4 has been taken as the point at which the prohibitive price of the products obtained from refining-oil will gradually lessen the demand. The 15% average annual increase over the 1913 price should therefore be used until oil has reached approximately \$4 per barrel, and the rate thereafter decreased gradually until \$4.50 is reached. The estimate of \$4.50 per barrel at the well as the upper limit at which refining oil will sell is justified by the rapid increasing demand for gasoline in the automotive industry.

It is conceded that the estimates of price for many years in advance cannot be determined with accuracy, but if the present value method of appraising oil properties is to be used, it is necessary to make some estimate of the gross price received for the product. The appraiser, however, is safeguarded to a certain extent by the comparatively small present-value of profits derived from oil properties ten or twenty years in the future. For example, a well producing in 1913, as a general rule, will have obtained most of its profit within ten years. The annual profit from that time onward, even though the price of oil is much higher than formerly, will be of comparatively small importance when discounted back to 1913.

As these conclusions and the premises upon which they are based have been reviewed by many engineers and heads of oil companies thoroughly conversant with Californian conditions in 1912 and 1913, and at subsequent dates, the conclusions may be taken as representing the consensus of opinion of those engaged in the oil industry of California.

Recent changes in the regulations for Federal taxation governing re-valuation of oil properties subsequent to discovery have made this problem of more importance than it was previously. Owing to these changes, it was not considered feasible in this report to consider with the care and thoroughness which the case demands the price-course of oil as of dates subsequent to March 1, 1913. From year to year new factors entered the problem, and the rate of increase for the future, when considered from the knowledge at hand as of dates subsequent to March 1, 1913, will probably be somewhat greater than those suggested in this report.

THE METAL BULLETIN of London calls attention to the critical state of the British smelting industry and, considering the possibility of obtaining zinc from other countries, points out that Germany, on account of lack of fuel and ore, is producing only about 3000 tons per month, no more than her own needs; that Belgium, producing now about 3000 tons per month, will need the

whole of her output in 1920 for sheet zinc; that France, on account of the destruction of her works and lack of coal, cannot be counted on for supplies in 1920; and that works in Holland are closed because of the prohibitive price of coal. The inference is that the United States will continue to export zinc to England at least for a year.

ANTIMONY before the War came chiefly from China, France, and Mexico. In France the production was largely from mines where the chief value of the ore was gold and the antimony was a by-product. The output of the principal mine has greatly decreased in recent years. The principal Mexican deposits occur in San Luis Potosi and Queretaro. Before the War the ore was chiefly exported to England; afterward a good deal of it came to the United States and a smelter was built at San Luis Potosi. The deposits in China have been developed during the past two decades, and formerly most of their product went to England for distribution. In 1915 the principal Chinese producers opened a sales office in the United States and now distribute direct to the American trade. Before the War the world's consumption of antimony was about 20,000 tons per year. During the War China produced at more than double this yearly rate. Accurate figures are lacking as to the output from Mexico, and France and its possessions, but it was certainly large. It is evident therefore that the world's present production capacity is far in excess of the normal demands. There was no production of antimony in the United States for some years previous to the War, other than in the form of antimonial lead, as already described. Deposits of antimony ores occur in a number of States, but the character and situation of the deposits is such as to make production costs too high to permit operation when the metal price is under 10c. per pound. In 1915, when the price was over 30c. per pound during most of the year, about 1500 tons of antimony was produced in the United States; but in 1917, when the price for most of the year was under 20c. per pound, the output fell off to 260 tons; and declined still further in 1918, when the price for the year averaged 12.58c. Certain individual deposits may be so fortunately situated as to permit operation at the normal price range (7c. to 10c. per pound) but in most cases the mining of antimony ores, except where their lead, silver, or gold content brings up the gross value to a working level, is not a profitable business in the United States at normal prices for the metal. From a military and economic standpoint it would seem desirable that industry in America should utilize the benefit of cheap antimony from abroad under normal trade conditions, and keep our own deposits intact as a reserve in case our overseas supply should be cut off in future wars.—Report for U. S. Bureau of Mines.

THE annual statement of the U. S. Geological Survey on the production of platinum and allied metals in 1918 is now available for distribution. A copy can be obtained by writing to the Survey at Washington, D. C.

Mr. Hoover's Address as President of the American Institute of Mining Engineers, on February 17, 1920

I have been greatly honored as your unanimous choice for President of this Institute with which I have been associated during my entire professional life. It is customary for your new president, on these occasions, to make some observations on matters of general interest from the engineer's standpoint.

The profession of engineering in the United States comprises not alone scientific advisors on industry but is in great majority comprised of the men in administrative positions. In such positions they stand midway between capital and labor. The character of your training and experience leads you to exact and quantitative thought. This basis of training in a great group of Americans furnished a wonderful recruiting ground for service in these last years of tribulation. Many thousands of engineers were called into the Army, the Navy, and civilian service for the Government. Thousands of high offices were discharged by them with credit to the profession and the nation.

We have in this country probably 100,000 professional engineers. The events of the past few years have greatly stirred their interest in national problems. This has taken practical form in the maintenance of joint committees for discussion of these problems and support to a free advisory bureau in Washington. The engineers want nothing for themselves from Congress. They want efficiency in government, and you contribute to the maintenance of this bureau out of sheer idealism. This organization for consideration of national problems has had many subjects before it, and I propose to touch on some of them this evening.

Even more than ever before is there necessity for your continued interest in this vast complex of problems that must be met by our Government. We are faced with a new orientation of our country to world problems. We face a Europe still at war; still amid social revolutions; some of its peoples still slacking on production; millions starving; and therefore the safety of its civilization is still hanging by a slender thread. Every wind that blows carries to our shores an infection of social disease from this great ferment; every convulsion there has an economic reaction upon our own people. If we needed further proof of the interdependence of the world, we have it today in the practical blockade of our export market. The world is asking for us to ratify long-delayed peace in the hope that such confidence will be restored as will enable her to reconstruct her economic life. We are today contemplating maintenance of an enlarged army and navy in preparedness for further upheavals in the world and failing to even provide some insurance against war by a league to promote peace.

Out of the strain of war, weaknesses have become even more evident in our administrative organization, in our

legislative machinery. Our Federal government is still over-centralized, for we have upon the hands of our Government enormous industrial activities which have yet to be demobilized. We are swamped with debt and burdened with taxation. Credit is woefully inflated; speculation and waste are rampant; our own productivity is decreasing. Our industrial population is crying for remedies to the increasing cost of living and aspiring to better conditions of life and labor. But, beyond all this, great hopes and aspirations are abroad; great moral and social forces have been stimulated by the War and will not be quieted by the ratification of peace. These are but some part of the problems with which we must deal. I have no fear that our people will not find solutions; but progress is sometimes like the old-fashioned rail fence—some rails are perhaps misshapen and all look to point the wrong way; but in the end, the fence progresses.

Your committees jointly with those of other engineering societies have had before them and expressed their views in many matters concerning the handling of the railways, shipping, the reorganization of Government engineering work, the national budget, and other practical items.

The war nationalization of railways and shipping are our two greatest problems in government control awaiting demobilization. There are many fundamental objections to continuation of these experiments in socialism necessitated by the War. They lie chiefly in their destruction of initiative in our people and the dangers of political domination that can grow from governmental operation. Beyond this, the engineers will hold that the successful conduct of great industries is to a transcendent degree dependent upon the personal abilities and character of their employees and staff. No scheme of political appointment has ever yet been devised that will replace competition in its selection of ability and character. Both shipping and railways have today the advantage of a skilled personnel, sifted out in the hard school of competition, and even then the government operation of these enterprises is not proving satisfactory. Therefore, the ultimate inefficiency that would arise from the deadening paralysis of bureaucracy has not yet had full opportunity for development. Already we can show that no government under pressure of ever-present political or sectional interests can properly conduct the risks of extension and improvement, or can be free from local pressure to conduct unwarranted services in industrial enterprise. On the other hand, our people have long since recognized that we cannot turn monopoly over to unrestrained operation for profit nor that the human rights of employees can ever be dominated by dividends.

Our business is handicapped on every side by the failure of our transportation facilities to grow with the coun-

try. It is useless to talk about increased production to meet an increased standard of living in an increasing population without a greatly increased transport equipment. Moreover, there are very great social problems underlying our transport system; today their contraction is forcing a congestion of our population around the great cities with all that these over-swollen settlements import. Even such great disturbances as the coal strike have a minor root in our inadequate transportation facilities and their effect upon the intermittent operation of our mines.

We are all hoping that Congress will find a solution to this problem that will be an advanced step toward the combined stimulation of the initiative of the owners, the efficiency of operation, the enlistment of the good-will of the employees, and the protection of the public. The problem is easy to state. Its solution is almost overwhelming in complexity. It must develop with experience, step by step, toward a real working partnership of its three elements.

The return of the railways to the owners places predominant private operation upon its final trial. If instant energy, courage, and large vision in the owners should prove lacking in meeting the immediate situation, we will be faced with a reaction that will drive the country to some other form of control. Energetic enlargement of equipment, better service, co-operation with employees, and the least possible advance in rates together with freedom from political interest will be the scales upon which the public will weigh these results.

Important phases of our shipping problem that have come before you should receive wider discussion by the country. As the result of war pressure, we will spend over \$2,800,000,000 in the completion of a fleet of 1900 ships of a total of 11,000,000 tons—nearly one-quarter of the world's cargo shipping. We are proud of this great expansion of our marine, and we wish to retain it under the American flag. Our shipping problem has one large point of departure from the railway problem, for there is no element of natural monopoly. Anyone with a watertight vehicle can enter upon the seas today, and our Government is now engaged upon the conduct of a nationalized industry in competition with our own people and all the world besides. While in the railways government inefficiency could be passed on to the consumer, on the seas we will sooner or later find it translated to the national Treasury.

Until the present time, there has been a shortage in the world's shipping, but this is being rapidly overtaken and we shall soon be met with fierce competition of private industry. If the Government continues in the shipping business, we shall be disappointed from the point of view of profits. For we shall be faced with the ability of private enterprise to make profits from the margins of higher cost of government operation alone. Aside from those losses inherent in bureaucracy and political pressure, there are others special to this case. The largest successfully managed cargo fleet in the world comprises about 120 ships and yet we are attempting to manage

1900 ships at the hands of a government bureau. In normal times the question of profit or loss in a ship is measured by a few hundred tons of coal wasted, by a little extravagance in repairs, or by the four or five days added on a round trip. Beyond this, private shipping has a free hand to set up such give-and-take relationships with merchants all over the world as will provide sufficient cargo for all legs of a voyage, and these arrangements of co-operation cannot be created by government employees without charge or danger of favoritism. Lest fault be found, our government officials are unable to enter upon the detailed higgling in fixing rates required by every cargo and character. Therefore, they must take refuge in rigid regulations and in fixed rates. In result, their competitors underbid by the smallest margins necessary to get the cargoes. The effect of our large fleet in the world's markets is thus to hold up rates, for so long as this great fleet in one hand holds a fixed rate, others will only barely under-bid. If we hold up rates, an increasing number of our ships will be idle as the private fleet grows. On the other hand, if we reduce rates we shall be under-bid until the government margin of larger operation cost causes us to lose money.

We shall yet be faced with the question of demobilizing a considerable part of this fleet into private hands, or frankly acknowledging that we operate it for other reasons than interest on our investment. In this whole problem there are the most difficult considerations requiring the best business thought in the country. In the first instance, our national progress requires that we retain a large fleet under our flag to protect our national commercial expansion overseas. Secondly, we may find it desirable to hold a considerable government fleet to build up trade-routes in expansion of our trade, even at some loss in operation. Thirdly, in order to create this fleet, we have built up an enormous ship-building industry. Fifty per cent of the capacity of our ship-yards will more than provide any necessary construction for American account. Therefore there is a need of obtaining foreign orders, or the reduction of capacity, or both. I believe, with most engineers, that, with our skill in repetitive manufacture, we can compete with any ship-builders in the world and maintain our American wage-standards; but this repetitive manufacture implies a constant flow of orders. It would seem highly desirable, in order to maintain the most efficient yards until they can establish themselves firmly in the world's industrial fabric, that the Government should continue to let some ship construction contracts to the lowest bidders; these contracts to supplement private building in such a way as to maintain the continuous operation of the most economical yards and the steady employment of our large number of skilled workers engaged therein.

When we consider giving orders for new ships, we must at the same time consider the sale of ships, as we cannot go on increasing this fleet. When we consider sale, we are confronted with the fact that our present ships were built under expensive conditions of war, costing from three to four times per ton the pre-war amount, and that

already any merchant, subject to the long time of delivery, can build a ship for 75% of their cost. It would at least seem good national policy to sell ships today for the price we can contract for delivery a year or two hence, thus making the Government a reservoir for continuous construction. We could thus stabilize building industry to some degree and also bring the American-owned fleet into better balance, if, as the Government sold three or four emergency constructed cargo vessels, it gave an order for one ship of a better and faster type. This would make reduction in our ship-building steadier and would give the country the type of ships we need.

Our joint engineering committees have examined with a great deal of care into organization of and our expenditure on public works and technical services. These committees have consistently and strongly censured the appalling inefficiency in the Government organization of these matters. They report to you that the annual expenditure on such works and services now amounts to over \$250,000,000 per annum, and that they are carried out today in nine different governmental departments. They report that there is a great waste by lack of national policy of co-ordination, in overlapping with different departments, in competition with each other in the purchase of supplies and materials and the support of many engineering staffs.

They recommend the solution that almost every other civilized government has long since adopted, that is, the co-ordination of these measures into one department under which all such undertakings should be conducted and controlled. As a measure practical to our Government, they have advocated that all such bureaus should be transferred to the Interior Department, and all the bureaus not relating to these matters should be transferred from the Interior to other departments. The committee concludes that no properly organized and directed saving in public works can be made until such a re-grouping and consolidation is carried out, and that all of the cheese-paring that normally goes on in the honest effort of Congressional committees to control departmental expenditure is but a tithe of that which could be effected if there were some concentration of administration along the lines long since demonstrated as necessary to the success of private business.

Another matter of government organization to which our engineers have given adhesion is in the matter of the national budget. To minds charged with the primary necessity of advance planning, co-ordination, provision of synchronizing parts in organization, the whole notion of our hit-or-miss system is repugnant. A budget system is not the remedy for all administrative ills; it provides a basis of organization that at least does not paralyze administrative efficiency as our system does today. Through it, the co-ordination of expenditure in government departments, the prevention of waste and overlapping in government bureaus, the exposure of the pork barrel, and the balancing of the relative importance of different national activities in the allocation of our national income can all be greatly promoted. Legislation would also be

expedited. No budget that does not cover all government expenditure is worth enactment. Furthermore, without such reorganization as the grouping of construction departments, the proper formulation of a budget would be hopeless. The budget system in some form is so universal in civilized governments and in competently conducted business enterprise, and has been adopted in thirty of our States, that its absence in our Federal government is most extraordinary. It is, however, but a further testimony that it is always a far cry of our citizens from the efficiency in their business to interest in the efficiency of their government.

Another great national problem to which every engineer in the United States is giving earnest thought, and with which he comes in daily contact, is that of the relationship of employer and employee in industry. In this, as in many other national problems today, we are faced with a realization that the science of economics has altered from a science of wealth to a science of human relationships to wealth. We have gone on for many years throwing the greatest of our ingenuity and ability into the improvement of processes and tools of production. We have until recently greatly neglected the human factor that is so large an element in our very productivity. The development of vast repetition in the process of industry has deadened the sense of craftsmanship and the great extension of industry has divorced the employer and his employee from that contact that carried responsibility for the human problem. This neglect of the human factor has accumulated much of the discontent and unrest throughout our great industrial population and has reacted in a decrease of production. Yet our very standards of living are dependent on a maximum productivity up to the total necessities of our production.

Another economic result is, or will be yet, a repercussion upon the fundamental industry of the United States, that is, agriculture. For the farmer will be unable to maintain his production in the face of a constant increase in the cost of his supplies and labor through shrinkage in productivity in other industries. The penalty of this disparity of effort comes mainly out of the farmer's own earnings.

I am daily impressed with the fact that there is but one way out, and that is to again re-establish through organized representation that personal co-operation between employer and employee in production that was a binding force when our industries were smaller of unit and of less specialization. Through this, the sense of craftsmanship and the interest in production can be re-created and the proper establishment of conditions of labor and its participation in a more skilled administration can be worked out. The attitude of refusal to participate in collective bargaining with representatives of the employees' own choosing is the negation of this bridge to better relationship. On the other hand, a complete sense of obligation to bargains entered upon is fundamental to the process itself. The interests of employee and employer are not necessarily antagonistic; they have a great common ground of mutuality and if we could secure emphasis

upon these common interests we would greatly mitigate conflict. Our Government can stimulate these forces, but the new relationship of employer and employee must be a matter of deliberate organization within industry itself. I am convinced that the vast majority of American labor fundamentally wishes to co-operate in production and that this basis of good-will can be organized and the vitality of production re-created.

Many of the questions of this industrial relationship involve large engineering problems, as an instance of which I know of no better example than the issue you plan for discussion tomorrow in connection with the soft coal industry. Broadly, here is an industry functioning badly from an engineering and consequently from an economic and human standpoint. Owing to the intermittency of production, seasonal and local, this industry has been equipped to a peak load of 25 or 30% over the average load. It has been provided with a 25 or 30% larger labor complement than it would require if continuous operation could be brought about. I hope your discussion will throw some light on the possibilities of remedy. There lies in this intermittency not only a long train of human misery through intermittent employment, but the economic loss to the community of over 100,000 workers who could be applied to other production, and the cost of coal could be decreased to the consumer. This intermittency lies at the root of the last strike in the attempt of the employees to secure an equal division among themselves of this partial employment at a wage that could meet their view of a living return on full employment.

These are but few of the problems that confront us. But in the formulating of measures of solution, we need a constant adherence to national ideals and our own social philosophy.

In the discussion of these ideals and this social philosophy, we hear much of radicalism and of reaction. They are, in fact, not an academic state of mind but realize into real groups and real forces influencing the solution of economic problems in this community. In their present day practical aspects, they represent on one hand roughly various degrees of exponents of socialism, who would directly or indirectly undermine the principle of private property and personal initiative, and, on the other hand, those exponents who in various degrees desire to dominate the community for profit and privilege. They both represent attempts to introduce or preserve class privilege, either a moneyed or a bureaucratic aristocracy. We have, however, in American democracy an ideal and a social philosophy that sympathizes neither with radicalism nor reaction as they are manifested today.

For generations the American people have been steadily developing a social philosophy as part of their own democracy—and in these ideals, it differs from all other democracies. This philosophy has stood this period of test in the fire of common sense; it is, in substance, that there should be an equality of opportunity—an equal chance—to every citizen. This view that every individual should, within his lifetime, not be handicapped in

securing that particular niche in the community to which his abilities and character entitle him, is itself the negation of class. Human beings are not equal in these qualities. But a society that is based upon a constant flux of individuals in the community, upon the basis of ability and character, is a moving virile mass; it is not a stratification of classes. Its inspiration is individual initiative. Its stimulus is competition. Its safeguard is education. Its greatest mentor is free speech and voluntary organization for public good. Its expression in legislation is the common sense and common will of the majority. It is the essence of this democracy that progress of the mass must arise from progress of the individual. It does not permit the presence in the community of those who would not give full meed of service.

Its conception of the State is one that, representative of all the citizens, will in the region of economic activities apply itself mainly to the stimulation of knowledge, the undertaking only of works beyond the initiative of the individual or group, the prevention of economic domination of the few over the many, and the least entrance into commerce that government functions necessitate.

The method and measures by which we solve this accumulation of great problems will depend upon which of these three conceptions will reach the ascendancy among our people.

If we cling to our national ideals it will mean the final isolation and the political abandonment of the minor groups who hope for domination of the Government, either by 'interests' or by radical social theories through the control of our political machinery. I sometimes feel that lawful radicalism in politics is less dangerous than reaction, for radicalism is blatant and displays itself in the open. Unlawful radicalism can be handled by the police. Reaction too often fools the people through subtle channels of obstruction and progressive platitudes. There is little danger of radicalism ever controlling a country with so large a farmer population, except in one contingency. That contingency is from a reflex of continued attempt to control this country by the 'interests' and other forms of our domestic reactionaries.

The mighty upheaval following the world war has created turmoil and confusion in our own country no less than in all other lands. If America is to contribute to the advance of civilization, it must first solve its own problems, must first secure and maintain its own strength. The kind of problems that present themselves are more predominantly economic—national as well as international—than at any period in our history. They require quantitative and prospective thinking and a sense of organization. These are the sort of problems that your profession deals with as its daily toil. You have an obligation to continue the fine service you have initiated and to give it your united skill.

MAGNESITE, the natural carbonate of magnesium, when calcined, forms a highly refractory material which has no thoroughly satisfactory substitute in the open-hearth process for making steel.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA

NOTES FROM HYDER.

HYDER.—That there will be something approaching a rush into the Salmon River district, in northern British Columbia, as soon as the season breaks appears certain. The development at the Premier mine and work on other properties in the vicinity, together with the staking of many new claims, have had the effect of attracting widespread attention to this part of the northern country. The towns of Hyder and Stewart, the portals through which prospectors and miners must pass, are booming. Real estate is said to be selling at high figures in both towns and it is known that many enterprising businessmen are waiting only for more propitious weather to establish themselves. Dale Pitt, assistant manager of the Premier mine, says that there is a misleading impression that the country is another Klondyke. He adds that it should be understood that it is a hard-rock camp and that money is needed to develop it. For the benefit of those who may not understand the conditions, Pitt's statement may be supplemented. In and around Hyder the snow usually remains until the month of April and in the hills it often persists until June. Although everything possible is being done to prepare for the accommodation of the hundreds of visitors looked for, those proposing the trip will be well advised to carry with them tents and blankets. The short road between Stewart and Hyder that involved extremely heavy and expensive construction is complete. The Premier company, it is understood, carried the road from Hyder through American territory to the Canadian boundary, from which point it was taken up by the Provincial authorities. It is announced that a special mail contract has been entered into for the benefit of the people of Stewart whereby mails are to be conveyed once a week during the winter and twice a week during the summer, transportation to be provided by a substantial powerboat.

ARIZONA

OPERATIONS AT KINGMAN AND OATMAN.

AJO.—The first diamond-drill hole on the Cornelia Extension has been completed and the second one has been commenced. The first hole was drilled to a depth of 800 ft. and is said to have revealed conditions satisfactory to the management.

KINGMAN.—Preparations are being made to install an electric hoist at the Emerald Isle property. The shaft in the west orebody is now down 50 ft. and has been sunk

through desert wash and gravel which has been cemented by oxidized copper minerals. Plans have been completed for an enlargement of the present electrolytic plant. Considerable excitement has been caused in Oatman by the opening of a large orebody in a cross-cut from the tunnel level of the Alexander mine of the Oatman Southern Mining Co. Owing to lack of money this property has been idle during the past year. The shaft of the Kingman has reached a depth of 30 ft. and a hoist and compressor have been installed. The property formerly went under the name of the Tipperary Mining Company.

Messrs. Imus and Hunt have opened a streak of high-grade silver ore in the Wallapai district, that is said to assay as high as 2000 oz. in silver per ton. The discovery was made close to the Hibernia property. There is considerable prospecting being done for silver in the vicinity of the Hibernia. The returns from shipments made by the McCracken Silver Lead Mines Co. during January showed a net return of \$2995. Four new tables have been installed in the mill and it is expected that this change will double the capacity of the mill.

MIAMI.—The vein of the Superior & Boston has been entered at a point 400 ft. east of the place where it was found on the 400-ft. level and shows an average of seven feet of excellent copper ore. Shipments of ore continue at the rate of five cars per week. Sinking of the shaft of the Iron Cap is being continued to the 1500-ft. level. Rapid progress is being made on the concentrator and the grading for the narrow-gauge railroad from the mine to the mill is nearing completion. Production is at the rate of 250 to 300 tons per day.

PATAGONIA.—It has been announced by H. K. Welch, president of the Hardshell Mining Co., that the new shaft which is now being sunk has reached the 400-ft. level. Sinking is to be continued to 500 ft., at which point cross-cutting will be done. Water has delayed sinking and has necessitated the installation of increased pumping facilities.

RAY.—The Gila Copper Sulphide Co. has been turned back to its owners by formal action of the United States court of Arizona, the receivership having been dismissed. The company has been reorganized and has ample capital.

TUCSON.—It is understood that a New York announcement has been made to the effect that the Mineral Hill Consolidated Copper Co., operating in the San Xavier district, twelve miles south of Tucson, is to undertake extensive development. It is also stated that negotiations are under way for an eight-mile railway to connect

the mine with the main line of the Southern Pacific railroad. Plans are completed for the erection of a 300-ton mill, there now being 500,000 tons of ore developed averaging more than 2% copper. The El Tiro Leasing Co. produced 262,600 lb. of copper in December, one-third of which came from development work. Drifting toward the Williams shaft on the 200-ft. level is being continued and raising on drill-hole No. 58 from the 200-ft. level is being done to open the high-grade ore which the drill passed through. Ore which was opened up on the 50 and 100-ft. levels has been proved on the 200-ft. level. Copper production is being curtailed awaiting a more favorable market.

COLORADO

VINDICATOR OFFICERS ELECTED.—LESSEES AT LEADVILLE ARE PRODUCING GOOD ORE.

CRIPPLE CREEK.—The annual meeting of the Vindicator Consolidated Gold Mining Co., recently held in Denver, resulted in the re-election of the old board of directors and officers. Guilford S. Wood is president; Adolph F. Zang, vice-president; George A. Stahl, secretary and general manager; Philip A. Zang, treasurer; and A. E. Carlton, Charles Sigel, Jr., and D. W. Strickland complete the board of directors. The annual report shows that despite the fact that the cost of mining supplies and labor continued at the highest level ever known, and the shortage of labor became more acute from month to month, operating profits totaled \$98,958 from gross production of \$692,041. This total includes the earnings from the ferro-alloy plant at Denver. During 1919 the company hoisted 143,400 tons of ore on company account, from which was produced 19,922 tons of shipping-ore with a gross value of \$718,136. The cost of marketing was \$129,250 and net returns \$588,885. Lessees produced 55,648 tons and shipments from this source aggregated 20,772 tons with a gross value of \$291,064. Royalties paid on lessees' shipments amounted to \$92,525.

The Lincoln Mines & Reduction Co. has started underground development of the Ironclad Hill properties of the Rex M. & M. Co., held under bond and lease. The Lincoln company's mill is on this ground and will shortly be operating. Recent tests have proved the newly-developed Gasche process to be suitable for the treatment of ores from the Ironclad Hill mine.

LEADVILLE.—Shipments aggregating ten cars monthly of lead-carbonate ore are leaving the Matchless mine, operated under bond and lease by Albert R. Bailey of Pueblo and associates, and heavy shipments from the orebody recently opened up in the No. 6 shaft will soon follow. Parts of the orebody are rich in silver and lead but the ores are not sorted prior to shipment. Prospecting work below the original discovery in the No. 6 shaft has indicated that the shoot is continuous. At the Lilian mine in Iowa gulch, Tim Riley, Samuel Thomas, and the Merceray brothers, who secured control about six months ago, are extending the tunnel to cut the shoots found in the upper workings. The tunnel will cut this unex-

ploited territory at a depth of 300 ft. The tunnel through which the operators are working was driven 40 years ago, and was badly caved when work commenced. It makes a convenient portal to the lower formation of the Iowa Gulch section. James Boni and Frank Barry, operating the Ollie Reed No. 2 property, are shipping a good grade of lead-silver carbonate ore, while drifting to get under a new orebody recently cut in the level above. With the shoot proved continuous a large body of ore will be available for stoping.

OURAY.—A rich vein of silver ore has been found in the Early Bird group of mines, on the divide between Animas Forks and Ouray. The owners, A. E. McCormick, George Gardner, Clay Ashley, and James Bass, purchased the property from a Pueblo company late last fall and they began to break trail to their mine on December 6. When work was begun the tunnel already was advanced 150 ft., and after driving 20 ft. farther a vein of copper and silver ore one foot wide was found. One sample assayed 14,000 oz. silver and 10% copper. Eighteen mules are packing the ore to Ouray, which is the shipping point. A car of ore will be completed this week.

MICHIGAN

OUTPUT OF COPPER DURING JANUARY.

HOUGHTON.—The completed compilation of the production of copper ore from the mines of the Lake Superior district, together with the actual or estimated reports of the smelter output of refined copper, indicate an increase over the figures for December 1919. With the exception of two, all the mines show an increase for January. In the case of Calumet & Hecla this increase was over 800,000 lb. The table follows:

Mine	Tonnage	Pounds per ton		Refined	
		January	December	January	December
Almееk	64,125	23.9	25.0	1,533,300	1,495,081
Allouez	20,000	20.0	19.2	400,000	376,100
Baltic	15,000	35.0	35.0	525,000	490,000
Calumet & Hecla	218,488	25.0	25.0	5,482,220	4,699,336
Centennial	7,500	16.6	16.6	122,600	124,311
Champion	49,000	40.0	40.0	1,960,000	1,840,000
Isle Royale	58,889	18.0	17.8	1,060,094	970,600
Michigan	4,148	25.3	21.0	104,848	96,467
Mohawk	46,629	21.88	20.99	1,020,212	1,019,904
Osceola Con.	55,000	14.31	16.0	787,300	895,000
Quincy	99,000	18.0	18.0	1,782,000	1,728,000
Trimountain	14,500	30.0	30.0	435,000	435,000
Victoria	7,850	16.0	12.0	125,000	167,000
Wolverine	20,622	13.62	14.63	281,052	327,970
Winona	11,000	13.9	16.0	153,140	147,420
White Pine	16,257	20.0	20.0	325,157	346,939

NEVADA

LESSEES ARE ACTIVE AT GOLDFIELD.—CANDELARIA PROPERTY BEING SAMPLED.

ARROWHEAD.—Enlarging of the shaft of the Arrowhead has been nearly completed and lateral work will be resumed soon. The shaft was too small for the amount of work being done and also was considered unsafe. Nineteen companies are working in the district, practically all sinking shafts, and some are using machine drills. The Arrowhead Consolidated company is cutting a station at 150 feet.

ROUND MOUNTAIN.—The Silver Shield, in Horse canyon, which was optioned recently by Tonopah and Gold-

field men, is being examined by engineers representing Eastern capital with a view to purchase. Five working faces, two in the main tunnel and three in tunnels lower in the vein, are in ore of shipping grade. A winze from the main tunnel has been sunk 60 ft. in rich ore that has shown a gradual increase in value. A 3-ft. shoot assays from 300 to 500 oz., according to one of the holders of the option. The lower tunnel, started recently, will cut the vein at a depth of 750 feet.

TONOPAH.—Labor conditions are again normal at Tonopah and Divide following the recent trouble. From 800 to 900 men are employed in both districts. Many are idle because of the refusal of the mine owners to employ them. It is said by members of both parties to the recent

Houlahan and his son, John Houlahan, refuse information on conditions. The Houlahans control the company, which has done a large amount of development work. The shaft is over 400 ft. deep and thousands of feet of lateral work has been done in a vein over 25 ft. wide. The ore being shipped assays from \$50 to \$100 per ton, according to reports, but the rate of shipment is slow. According to reliable reports the Eagle contains a body of mill-grade ore of sufficient size to make it of great value, in view of the rise in the price of silver. The ore contains much sulphur and arsenic. Officials of the Yellow Tiger report that the assessment has been paid on 85% of the outstanding stock. The surface of the ground owned by the company is being prospected, but the man-



VIRGINIA CITY, THE SCENE OF REVIVED ACTIVITY

dispute that there is no danger of further trouble for the present.

CACTUS.—Bids are being received by the Cactus Nevada for sinking the shaft 100 ft. from the present depth of 200 ft. and, as \$10,000 is now available, it is thought work will start within a month; the present fund being increased as stock is sold in the East. The shaft will be sunk to 600 ft., contracts being let for each 100 ft. The west drift on the 160-ft. level has cut an ore-shoot opened on the 100-ft. level and assays of 75 to 100 oz. silver are being secured.

TULE CANYON.—Work is to be started on the Ingalls on March 12 by the holders of the option. The option was for 30 days from February 12, and Harry Stimler, who negotiated the sale, secured an extension for one month by paying \$1000. The former owners are treating in the mill a small tonnage of ore mined before the sale was made.

GOLDFIELD.—The Nevada Eagle, $3\frac{1}{2}$ miles west of here, has resumed shipments of silver ore after years of idleness during which the mine was almost forgotten. J. M.

agement reports that no deep work will be undertaken while the present unfavorable conditions for the development of gold prospects exist. The company is in a strong financial position. The Dunn lease on the Engineers' block in the Florence has shipped a carload of \$32 ore and the Adamson, Traynor, and McCall lease has shipped a carload of \$40 ore. Interest centres on the Cracker Jack lease, which promises to develop into a larger producer than the Florence Divide was last year, according to R. C. McCarthy, superintendent of the Florence. Ore containing free gold in quantity has been opened on the 500-ft., or bottom, level of the Little Florence shaft in the Cracker Jack lease, and a shoot of high-grade ore also is being developed on the 258-ft. level of the Florence shaft. Good ore has been found at a number of other places heretofore unexplored, but it will require from two weeks to a month to determine whether the ore is persistent for a distance sufficient to make the shoots of value. At a depth of 1022 ft. the Spearhead company is drifting in a quartz-filled fissure in the granite. The drift is being driven from the bottom of a winze from the 910-ft. level.

CANDELARIA.—Edwin S. Giles, Goldfield mining engineer, recently inspected the Georgene, adjoining the Candelaria, and it is reported that the Jackling interests, said to control the Candelaria, are planning to take over an option held by Goldfield men. The Georgene has been developed to a depth of 450 ft. In the early days ore assaying less than \$25 could not be handled at a profit and the filling in large stopes assays from 10 to 12 oz. silver. There is a large undeveloped area in which a number of the main veins of the district centre and this is thought to be the reason the Jackling interests are anxious to secure the Georgene. The silver is found in altered limestone and crushed porphyry and the ore occurs in lenses in the veins. According to Mr. Giles, the timbers are as good as when put in place and in general the mine is in nearly perfect condition. The engineer found in the mine a copy of the 'Mining and Scientific Press' issued in 1889 in newspaper form and containing an article on the Candelaria district in which the Georgene was mentioned. Charles D. Kaeding, manager for the Dome Mines Co. at Porcupine, is in charge of the sampling of the Candelaria and 10,000 samples will be taken.

TECOPA.—Shipments of talc are being made from Acme, north of here, to Los Angeles, where the material is ground and shipped to the Colgate company for use as talcum powder. The talc, which occurs in veins from 2 to 20 ft. wide, is mined through an 80-ft. shaft. The rate of shipment is slow and the profits are small because of the long railroad hauls and because frequent increase in the lime content makes considerable prospecting necessary.

UTAH

SYMPATHETIC STRIKE AT PARK CITY IS A FAILURE.—MINERS STILL OUT AT BINGHAM.

BINGHAM.—The United States company's mines at Bingham produced 130,911 dry tons of ore during 1919, from which was obtained 21,814 oz. gold, 575,868 oz. silver, 20,061,757 lb. of lead, 1,045,060 lb. of copper, and 130,911 lb. of zinc, having a gross value of \$2,438,385. The cost of extraction was \$720,495; of reduction, \$1,467,025; of transportation, \$85,802; and of construction, \$8765; a total of \$2,282,078; leaving net proceeds for the year, \$156,307.

The strike which became effective on the morning of February 10 is still on, according to I. W. W. leaders. At most of the mines, except the United States, a number of employees have returned to work, but it is estimated that fully 600 miners have left town, and even if the strike should be called off, it would be some time before the mines could build their forces up to what they were on February 9. Operations of the Utah Copper company have continued without any interruption.

EUREKA.—Nineteen mines in this district shipped a total of 141 cars of ore during the week ending February 14, as compared with 175 carloads for the previous week. The Chief Consolidated shipped 42 carloads; the Dragon, 20; Tintic Standard, 18; Eagle & Blue Bell, 11; Iron

Blossom, 10; Gemini, 8; Colorado, 7; Grand Central, 7; Centennial-Eureka, 5; Bullion Beck, 3; Swansea, 3; Victoria, 3; Sunbeam, 2; Ridge & Valley, 2; Mammoth, 2; Eureka Mines, 1; Godiva, 1; K. C., 1; Alaska, 1.

The Centennial-Eureka mine, owned by the United States Smelting, Refining & Mining Co., produced 21,288 tons of ore during 1919, having a gross value of \$514,017. This tonnage yielded 7458 oz. gold, 230,007 oz. silver, 54,712 lb. of lead, and 601,567 lb. of copper. Total costs were \$494,794, of which \$252,474 was expended on extraction; \$192,592 on reduction; and \$49,727 on transportation; leaving net proceeds of only \$19,223.

Stockholders of the Selma Mines Co. at a recent meeting elected the following directors: W. I. Snyder, J. C. Jensen, R. A. Brown, C. J. Peterson, and E. T. Walton. At a directors' meeting which followed, W. I. Snyder was elected president; J. C. Jensen, vice-president; and Gideon Snyder, secretary-treasurer. The property of this company, consisting of 560 acres, adjoins the Tintic Paymaster mines on the south, with the Chief Consolidated and the Central Standard also adjacent. A shaft, one compartment, and a manway, has been sunk upon a large fissure to the 250-ft. level. At this depth about 2500 ft. of drifting has been done. A mineralized zone was penetrated, but inasmuch as the formation indicated that leaching action had taken place, it was decided that sinking would be continued.

Three feet of rich ore, with gray copper and chalcopryite predominating, is showing in the face of the south drift of the Eureka Lilly mine on the 1650-ft. level. It is the opinion of the officials of the company that a cross-break is being approached, and interesting developments are looked for.

A full face of first-class ore was found on the 1450-ft. level of the Tintic Standard mine shaft No. 2, according to E. J. Raddatz, president. The 1450-ft. level is the lowest in the mine. Recently a station was cut on this level and an east drift started from the shaft. The find was made at a distance of approximately 120 ft. from the shaft, and inasmuch as it was made on the lowest level, it is of extra importance.

Drifting from the 350-ft. level of the Tintic Paymaster mine is continuing steadily, and nine feet is being made each day. In the last 600 ft. of drifting, three veins from 5 to 14 ft. wide have been cut. In another 200 ft. it is expected that an important north-south fissure, which on the surface shows promising mineralization, will be cut at a vertical depth of approximately 500 feet.

PARK CITY.—An average of 20 tons per day is being produced by the Naildriver mine; this output will be materially increased as soon as better hauling and storing facilities can be arranged. The last shipment to a valley smelter averaged 31 oz. silver and 11% lead. In the Dunyon cross-cut in the foot-wall of the vein on the 600-ft. level, four feet of ore, averaging 30 oz. silver and 10% lead, has been followed for a distance of 30 feet.

An effort on the part of Albert Wills, I. W. W. agent, and other bearers of the red card, to start a strike of miners in this district in sympathy with the striking

Bingham miners, failed on February 15. A meeting had been called by Wills, which was attended by 250 miners. A. J. Berg, secretary of the local of the International Mine, Mill & Smelter Workers' Union, a branch of the American Federation of Labor, got the floor and vigorously denounced Wills and the I. W. W.'s in general, saying that he had been converted against them after statements made by Wills at the time of the strike in this camp last summer. Berg accused Wills of preaching a doctrine of destruction. A vote was then taken on the proposition of striking, only 15 men voted in favor. The identity of these 15 men is not known, but it is said that most of them came into camp during the two or three days preceding the meeting, apparently from the Bingham district. A day or two after the meeting, demands were sent by mail to all of the local mines, asking for a \$6

BRITISH COLUMBIA

LEGISLATION REGARDING PLACER CLAIMS EXPECTED.

VICTORIA.—Mining men anticipate that some important amendments to the Placer Mining Act of British Columbia will be considered by the Provincial Legislature during the session now in progress. There are over 1100 placer-mining leases in the Province, of which something over 170 are fully paid up in regard to their rentals. The arrears can be readily understood when it is stated that the annual fee for a creek claim is \$75 and that for a bench claim \$50 and that \$1000 assessment work is required on each lease, making a very considerable sum in the aggregate. It is thought likely that the fees will be reduced, especially in respect of the amount of assessment work required, which will be placed more on a par with



FIRST STREET, STEWART, BRITISH COLUMBIA

minimum wage; an 8-hour day, collar to collar; and similar concessions demanded at Bingham. No attention was paid to these letters, and on February 17 a strike was supposed to become effective. About 20 men, newcomers in the camp, drew their time. On the evening of the 17th, a crowd of 150 miners gathered with the avowed intention of running all I. W. W.'s out of the district, but cool heads advised against violence, and the agitators, who were under cover, were not molested. The action of the agitators in this district is the same as in other mining camps. Not expecting their demands to be granted, they followed them up with a strike order, without giving mine owners sufficient time even to discuss the matter among themselves.

ALTA.—The Columbus Rexall Mining Co. produced 1337 tons of ore during 1919, from which was obtained 7842 oz. silver and 148,950 lb. of copper, the gross value of which was \$39,688.

The Little Cottonwood Transportation Co. may resume operations March 1, if present favorable weather conditions continue, according to Shand Smith, manager.

the terms of the Mineral Act; only \$100 assessment work per annum is asked for on a lode claim. Probably some arrangement will be made for the payment of arrears on leases which have been under development or upon which it can be satisfactorily shown that development is planned. But such ground as is held, manifestly, for purposes of speculation no doubt will be thrown open and the leases cancelled.

With the acquirement by the Consolidated Mining & Smelting Co. of a bond on the Big Interior group of claims, situated about ten miles from the head of Great Central lake, on Vancouver Island, energetic development of the property is expected. It has been handicapped by lack of transportation, and since the expense of proving its value is necessarily large, little has been done heretofore in the way of development.

ALICE ARM.—Despite the fact that the district is in the grip of a more than usually severe winter, there is activity at the mines. The Dolly Varden mine has been sending about 2½ tons of ore per day to tide-water in sleds drawn by dogs and horses. The use of this form of

transit, over the 18 miles between the mine and tide-water, in preference to waiting until spring, indicates the unusually high grade of the ore. The ore is being shipped to the Selby smelter. The Taylor Engineering Co. is establishing a camp at the Wolf mine, where a building for a compressor is being erected. As soon as the weather permits, the Alice Arm-Dolly Varden railway is to be extended to this mine. This extension will benefit the North Star, Toric, Tiger, Musketeeer, and other mines. A quantity of ore is ready for shipment at the North Star mine, but will be held pending the extension of the railway. Price & Keith, of New York, who are interested in the Premier mine, have bonded the Last Chance mine and have a diamond-drill working two shifts per day. As soon as the exploration work has been completed, the drill will be moved to a property owned by E. Pickell, which has been bonded to the same syndicate. A steam-driven compressor will be installed at the Dolly Varden, to replace the two gasoline-driven compressors, which have not given satisfaction.

SLOCAN.—M. S. Davys will operate the Hewill mine, at Silverton. This mine was bonded by Clarence Cunningham, but the bond was relinquished after a season's exploration work. The Standard mine is coming rapidly to the front again. During December a profit of \$30,016 was made, against \$7598 for the previous month. The Silversmith Mines, Ltd., has decided to call in its preferred stock and to issue common in its stead. The issue of common up to the end of last year totaled \$103,044 and the preferred \$165,193, of which latter \$99,239 was subject to call. During last year 14,558 tons of ore was mined; 325 tons of high-grade ore was sent direct to the smelter; and the balance was concentrated in the company's mill. The resulting concentrate was divided between Trail and United States smelters, Trail receiving 19 cars of lead and 3 cars of zinc concentrate and the United States smelters getting 17 cars of lead and 21 cars of zinc concentrate. There is an estimated ore-reserve in the mine of 90,000 tons. A. L. McPhee and Pat Maguire, who leased the Ottawa mine from the Consolidated company, have sent over 100 tons of ore to Trail during the winter. Maguire and J. T. Tipping are developing the Republic mine and have a car of ore ready to ship. M. S. Davys has purchased a controlling interest in the Silver Bear mine. This property was bonded by R. F. Green and partner with the view to operating it with the Silver Bell, but the bond was relinquished.

ONTARIO

PRODUCTION AT NIPISSING.

During the week ending February 13 the Nipissing company and the Mining Corporation shipped 401,000 oz. of silver bullion. The indicated price of \$1.55 per ounce makes a total value of \$622,000 for the week's shipments, all of which were consigned to the Far East, payment being made in New York. For the month of January the Nipissing mine produced \$329,401. Hugh Park, manager, in his monthly report, states: "Underground development and production were satisfactory for the

month, notwithstanding that it was a short period, as a result of the annual clean-up at the mills and general repair work at the various shafts." Max Morgenstern, of New York, a minority shareholder in the Buffalo Mines, has applied for an injunction restraining the Mining Corporation from exercising what was believed to be its rights in connection with the Buffalo mine, following the recent purchase of control.

W. E. Simpson has been appointed engineer and general manager of the Miller Independence mines, on Boston creek. The property came into prominence about a year ago following the discovery of a vein containing calaverite in spectacular quantities. Nine years experience mining telluride ore in Western Australia especially fits Mr. Simpson for his present position. The Miners' Union in this district is arranging to take a referendum of its member for the purpose of determining its future course; that is, whether it will remain with the International or break away and form a district organization.

TORONTO.—An organization to be known as the Ontario Mining Association has been formed with a view to promoting the interests of the mining industry. Details of organization have not been completed, but officers were elected as follows: President, A. D. Miles, of the International Nickel Co.; first vice-president, F. L. Culver, president of Beaver and Kirkland Lake mines; second vice-president, G. C. Bateman, general manager La Rose mine; secretary, B. Neilly. A company without capital will be incorporated and an office maintained at Toronto.

PORCUPINE.—The McIntyre has opened up three levels below 1000 ft., at 1125, 1250, and 1375 ft., and is establishing a main tramping level at 1375 ft. An excellent grade of ore is being opened up and preparations are being made for stoping. The shaft has now reached a depth of 1500 ft. The company is encountering serious difficulties from water in its operations on the Plenaurum property, which may result in its option being dropped.

At the Dame Lake drifting is being done on the 600-ft. level to pick up orebodies indicated by diamond-drilling, which have yielded high assays. The mill during the three months in which it was in operation last year treated 4433 tons of ore with a recovery of \$23,832. The North Davidson is getting machinery for a mining plant, which will be installed as soon as possible.

KIRKLAND LAKE.—The camp is experiencing a decided boom, a large number of properties having lately changed hands. The Lebel township section of the area is attracting many investors. The Kirkland Combine and Boston McCrea companies have taken over claims in this neighborhood and several important transactions are being negotiated. The Wood-Kirkland has engaged John Murphy to take charge of operations which are planned to begin within a month. The Ontario-Kirkland is nearly ready to resume operations. About 1000 ft. of lateral work has been done on the 300-ft. level and several good veins cut. Two shoots of ore 200 ft. and 100 ft. long and 5 ft. wide carry high-grade ore. The Kirkland Combine shaft is down 150 ft. Four parallel veins cut by diamond-drilling will be developed on the 250-ft. level.

THE MINING SUMMARY

ALASKA

Hyder.—O. B. Bush of Vancouver has purchased the Glacier group, on the Canadian side of the international line, and the Gray Dawn group, adjoining the Glacier, but on the Alaska side. The first consists of eight claims and fractions and is situated just west of the Indian Mines group. There has been practically no work done on the property as it was located only last summer. The owners were William Hedges, William Jancowski, H. S. Scovill, and Harry Reid. It is understood that Mr. Bush will incorporate a company to operate, and that the vendors will receive from him a cash consideration and a certain amount of stock. The Gray Dawn group consists of seven claims also of recent location. Both are well situated and Mr. Bush will prove next summer what their value may be. The vendor of the Gray Dawn is H. H. Howard.

ARIZONA

Superior.—The Silver King of Arizona Mining Co. reports that the new shaft had been completed to the 616-ft. level, where a vein was intercepted assaying 188 oz. silver per ton. In the No. 3 east stope, 40 ft. from the old workings in virgin ground and 70 ft. above the 400-ft. level, a new body of ore has been found which is 10 ft. wide and assays 25.8 oz. silver.

CALIFORNIA

Grass Valley.—The south cross-cut from the 400-ft. level of the Alcalde mine has opened a shoot of ore showing free gold. Work has begun to determine extent of this orebody. The property was formerly known as the Kenosha and produced a considerable quantity of high-grade ore. Milling ore is exposed and the mill is to go into operation at an early date. Lloyd Root is superintendent.—The Coe mine has been sold for taxes to L. P. LaRue of Grass Valley for \$1025.

Nevada County.—The Red Ledge company, operating near Washington under the management of Lewis Hind, has started to extend the lower tunnel into the ore-shoot. The tunnel is more than 900 ft. long and it is estimated that another 300 ft. will cut the rich vein found in the upper levels.—An important strike has been made in the Kenosha on the 400-ft. level. A blast disclosed a 3-ft. vein of quartz sprinkled with free gold.—W. H. Martin of Nevada City has purchased the Celia, Free Trade, and Red Cross group near Omega at a delinquent tax sale, for \$1389. The property is equipped with a 20-stamp mill and other machinery.

Oroville.—Several new hydraulic properties will be in operation east of here within a few weeks.

At Scales, the old Council Hill property is expected to resume under the management and control of H. L. Berkey, while over in the Gravel Range and a few miles south-west from Buck's ranch, the Old Channel mine will be running monitors under the direction of B. S. Taylor.

At Spanish ranch, in Plumas county, the Australia Placer Co., in which Carl Wolfe and Henry Orr are interested, has built a retaining dam according to Federal specifications, and flumes will soon be carrying tailing from the mine, depositing it behind the new barrier in Waupanese creek.

H. J. Greenbower will hydraulic at the Mt. Ararat mine

near Buck's ranch, and G. W. Fagg of the Gold Mountain Hydraulic expects another remunerative season despite the light snowfall to date.

Quincy.—The Onion Valley Mining Co. has arranged to resume work on its properties in Onion valley. Approximately 2800 ft. of tunnels already has been driven. W. A. Hunter is resident manager.

Spanish Ranch.—The Australia Placer Co. has erected a retaining barrier on Waupanese creek and is preparing for large-scale work. An extensive deposit of gold-bearing gravel is exposed and the property is well equipped.

IDAHO

Coeur d'Alene.—The Hecla Mining Co. has declared a dividend of 15c. per share, totaling \$150,000, to be paid March 28 to stockholders of record at the close of business March 1. This payment will make the total amount of dividends \$8,005,000.

MISSOURI

Barry County.—The contract for construction work on the Silver Lake Mining Co.'s \$1,000,000 'cyanide process' reduction plant at Seligman, has been awarded, according to word received in Joplin. Work will be started within a short time on the actual construction of the plant, which means the opening of a new mining district in south-west Missouri.

MONTANA

Butte.—Daily shipments of manganese ore are being made by the Anaconda company from the Emma mine of the Butte Copper & Zinc Co. to the ferro-manganese plant at Great Falls. Ferro-manganese at the present time is selling at \$140 per ton with the demand good. Shipments of 100 tons per day are being made and 40 tons of ferro-alloy is produced. A tonnage of manganese ore has been blocked out at the Emma mine, larger than can be found in any other property in the United States. Recently a silver-zinc orebody was opened at the Emma mine which now has a width of 17 ft. Anaconda is driving south from the Emma to connect with the workings of the old Ophir mine.

NEW MEXICO

Hanover.—The Empire Zinc Co. has purchased the entire capital stock of the Republic Mining & Milling Co. at \$1.25 per share. This brings the amount paid for the mine to just over half a million dollars. The property transferred consists of two groups and a single claim all lying close to the Hanover property of the Empire Zinc Co. There is the Welch group containing 90 acres, the Abrahamson group containing 175 acres, and the Silver Dollar containing 17 acres. The property is opened by three shafts and to a depth of 200 ft. All these shafts are in ore. The outstanding feature of the mine is a body of high-grade zinc ore which was cut recently in a drift on the 150-ft. level of the No. 1 shaft and about 90 ft. from the shaft.

OKLAHOMA

Picher.—The Hunt Mining Co. is preparing to erect a larger and better mill than the one known as the Pittsburg-Miami that was recently destroyed by fire, and work will be started as soon as insurance adjustments have been made. The company owns several other properties in the Kansas-Oklahoma field, all under the management of C. C. Whittier.

UTAH

Salt Lake City.—During 1919 the Utah Copper Co. mined 5,661,941 tons of ore, from which was produced 28,907 oz. gold, 263,721 oz. silver, and 105,088,740 lb. of copper, the gross value of which was \$19,554,541. The cost of production and construction items amounted to \$13,518,508, leaving net proceeds of \$6,036,033, as against \$13,891,522 in 1918. The total amount of dividends paid during 1919 was \$9,746,940.—The itinerary of the Bureau of Mines car No. 11, assigned to the intermountain district for instruction of miners in first-aid and in mine-rescue work for the period from February 22 to May 1 follows: Wendover, Utah, February 22 to 28; McGill, Nevada, March 1 to 13; Ely, March 15 to 20; Kimberly, March 22 to 27; Elko, March 29 to April 3; Eureka, April 5 to 17; Battle Mountain, April 19 to 24; Austin, April 26 to May 1.

WASHINGTON

Spokane.—At its closing session on February 20, the Northwest Mining convention adopted, after two days of discussion, a resolution which virtually admitted inability to solve the gold situation. Part of the text follows:

"Whereas, Owing to the world war, the ratio between national and international credits and metallic reserves has far exceeded the limit of safety; and

"Whereas, The production of gold, the world's metallic standard of value, cannot be profitably carried on under present conditions in quantity sufficient to maintain the world's metallic reserves; and

"Whereas, There is a wide difference of opinion as to how the market value of gold may be increased to the point of profitable production; and . . .

"Be it resolved, That the Northwest Mining convention, assembled at Spokane, Washington, February 16-21, 1920, and representing the States of Montana, Idaho, Washington, and Oregon, and the Province of British Columbia, hereby urges and petitions the President of the United States to call forthwith and by proper procedure a conference of qualified international experts for the express purpose of devising ways and means of safeguarding the world's credits by increasing the world's metallic reserves of gold, or by such other expedients as may be deemed safe and certain; and

"Be it further resolved, That as a temporary expedient to preserve the gold-mining industry until such international conference has arrived at a permanent solution we endorse the resolutions adopted by the American Mining Congress at St. Louis, November 1919, asking for a premium of \$10 per ounce upon new gold, such premium to be raised in part by an excise tax of the same amount per ounce upon all gold used in the arts or for other than monetary purposes."

ONTARIO

Cobalt.—Three shipments of silver bullion were made to Shanghai, China, last week valued at \$405,130. This is the richest consignment ever sent out in one week. They comprised 200,168 oz. from the Nipissing and 100,388 oz. from the Mining Corporation of Canada. The annual report of the Temiskaming shows a production of 243,037 oz. of silver, compared with 420,078 oz. in 1918. Earnings were \$295,252 as compared with \$425,014. The surplus for the year was \$70,448 and the total surplus \$993,186. Operating costs averaged \$15.61 per ton milled.—The Kerr Lake during January produced 108,000 oz. of silver.

SALVADOR

For some time the Butters Divisadero Co. has been negotiating for an operating agreement or the outright acquisition of the Mina de Encuentros. Nothing was accomplished, however, and the Encuentros mine is now free of all option liens and purchase contracts. The original owners, sons of Felipe Macay, are operating the mine as before the mentioned negotiation.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. C. Ray is on his way to Butte, Montana.

R. C. Gemmell and L. S. Cates are in New York.

W. J. Loring has been on a visit to Grass Valley.

John Smeddie is on his way to Guanajuato, Mexico.

Frank C. Loring has returned from London to Toronto.

J. M. Sully, general manager for the Chino Copper Co. in New Mexico, has gone to New York.

Adelrich Benziger, recently with the Seoul Mining Co., in Korea, has returned to New York.

A. E. Drucker has been appointed professor of metallurgy at the Wisconsin State School of Mines.

Lewis A. Parsons, associate editor of the 'M. & S. P.', is at Jerome; he will go later to Ajo, Arizona.

H. A. Kursell, manager for the Altai Mines, Ltd., passed through San Francisco on his way to London.

Solon Spiro, president of the Silver King Consolidated Mining Co. at Park City, Utah, is in New York.

Julius Kruttschnitt, Jr., consulting engineer to the A. S. & R. Co., is examining mines in Sinaloa, Mexico.

George Kingdon, superintendent of the U. V. X. mine, at Jerome, is undergoing treatment at Rochester, Minnesota.

Y. Fukihara and H. Nakamoto, both of the Mitsubishi Mining Co., are visiting mines and smelters in the South-West.

Lu-Cheng Chiang, a graduate of the Colorado School of Mines, sailed on the 'Nanking' on his way home, last Saturday.

C. W. Whitley, vice-president of the A. S. & R. Co., is making a tour of inspection of the company's smelters in Utah.

H. R. Robbins has been appointed mill-superintendent for the Hanover Bessemer Iron & Copper Co. at Fierro, New Mexico.

C. C. Gordon, who has been spending the winter at Salt Lake City, has gone to Bolivia and Chile on professional business.

H. S. Munroe, general manager for the Consolidated Coppermines Co., at Kimberly, Nevada, was in San Francisco this week.

Charles B. Croner has returned to Los Angeles, after spending some time with the Natomas Dredging Co. to study their dredging methods.

E. C. Montgomery has resigned as superintendent of the Kate Hardy mine at Forest to take over and open up a mine near Auburn, in Placer county.

N. P. Nissen, Lieutenant-Colonel B. E. F., addressed the Engineering Society of Queen's University on January 30, describing the Nissen hut, which he invented.

A. M. McDermott sailed on the 'Mazatlan' on February 16 for Choix, in Sinaloa, Mexico, where he will have his headquarters as general manager for the El Fuerte Mining & Smelting Co.

Obituary

George Z. Edwards, a well-known mining engineer of Utah, and a resident of Salt Lake City for 25 years, died at his home on February 16. For a number of years he was identified with the Dern mining interests at Mercur, and recently has been acting as superintendent of the Lynn Big Six property at Carlin, Nevada. He was a native of Pennsylvania, and before coming to Utah was engaged in mining in Colorado and Montana.

THE METAL MARKET



METAL PRICES

San Francisco, February 24

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	12.00
Copper, electrolytic, cents per pound.....	19.00
Lead pig, cents per pound.....	9.00—10.00
Platinum, pure, per ounce.....	\$155
Platinum, 10% iridium, per ounce.....	\$180
Quicksilver, per flask of 75 lb.....	\$80
Spelter, cents per pound.....	10.00
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

February 23—Copper is more active and firm. Lead is active and stronger. Zinc is active and higher.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Jan. 17.....	130.00	84.75	Jan. 13.....	133.71	79.49
" 18.....	130.00	84.00	" 20.....	132.04	78.81
" 19.....	130.00	83.75	" 26.....	132.58	80.00
" 20.....	130.00	82.62	Feb. 2.....	134.37	83.83
" 21.....	130.00	82.62	" 9.....	132.50	87.69
" 22 Sunday.....			" 16.....	132.10	85.72
" 23 Holiday.....			" 23.....	130.00	83.55

Monthly averages	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.82	106.36
Feb.	85.79	101.12	.....	Aug.	100.31	111.35
Mch.	88.11	101.12	.....	Sept.	101.12	113.92
Apr.	85.35	101.12	.....	Oct.	101.12	119.10
May	89.50	107.23	.....	Nov.	101.12	127.57
June	99.50	110.50	.....	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan.	23.50	20.43	18.25	Jan. 13.....	26.00	20.82	.....
Feb.	23.50	17.34	.....	" 20.....	26.00	22.51	.....
Mch.	23.50	15.05	.....	" 26.....	26.00	22.10	.....
Apr.	23.50	15.23	.....	Feb. 2.....	26.00	21.66	.....
May	23.50	15.91	.....	" 9.....	26.00	20.45	.....
June	23.50	17.53	.....	" 16.....	26.00	18.55	.....

Monthly averages	1918	1919	1920	1918	1919	1920
Jan.	8.75	9.00	8.75	July	8.05	5.78
Feb.	8.75	9.00	8.75	Aug.	8.05	6.02
Mch.	8.75	9.00	8.75	Sept.	8.05	6.40
Apr.	8.75	9.00	8.75	Oct.	8.05	6.76
May	8.75	9.00	8.75	Nov.	8.05	7.12
June	8.75	9.00	8.75	Dec.	8.05	7.12

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan.	8.85	5.60	8.65	Jan. 13.....	8.03	5.53	.....
Feb.	7.07	5.13	.....	" 20.....	8.05	5.78	.....
Mch.	7.26	5.24	.....	" 26.....	8.05	6.02	.....
Apr.	6.99	5.05	.....	Feb. 2.....	8.05	6.40	.....
May	6.88	5.04	.....	" 9.....	8.05	6.76	.....
June	7.59	5.32	.....	" 16.....	8.05	7.12	.....

Monthly averages	1918	1919	1920	1918	1919	1920
Jan.	8.85	5.60	8.65	July	8.03	5.53
Feb.	7.07	5.13	.....	Aug.	8.05	5.78
Mch.	7.26	5.24	.....	Sept.	8.05	6.02
Apr.	6.99	5.05	.....	Oct.	8.05	6.40
May	6.88	5.04	.....	Nov.	8.05	6.76
June	7.59	5.32	.....	Dec.	8.05	7.12

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan.	85.13	71.50	62.74	Jan. 13.....	93.00	70.11	.....
Feb.	85.00	72.44	.....	" 20.....	91.33	62.20	.....
Mch.	85.00	72.60	.....	" 26.....	80.40	55.79	.....
Apr.	85.53	72.50	.....	Feb. 2.....	78.82	54.82	.....
May	100.01	72.50	.....	" 9.....	73.87	54.17	.....
June	91.00	71.83	.....	" 16.....	71.52	54.94	.....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan.	7.78	7.44	9.56	Jan. 13.....	8.72	7.78	.....
Feb.	7.97	6.71	.....	" 20.....	8.78	7.81	.....
Mch.	7.67	6.53	.....	" 28.....	9.58	7.57	.....
Apr.	7.04	6.49	.....	Feb. 2.....	9.11	7.82	.....
May	7.92	6.43	.....	" 9.....	8.75	8.12	.....
June	7.92	6.91	.....	" 16.....	8.49	8.60	.....

Monthly averages	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78
Feb.	7.97	6.71	.....	Aug.	8.78	7.81
Mch.	7.67	6.53	.....	Sept.	9.58	7.57
Apr.	7.04	6.49	.....	Oct.	9.11	7.82
May	7.92	6.43	.....	Nov.	8.75	8.12
June	7.92	6.91	.....	Dec.	8.49	8.60

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan. 27.....	90.00	.....	.....	Jan. 13.....	120.00	100.00	.....
Feb. 3.....	85.00	.....	.....	" 20.....	120.00	103.00	.....

Monthly averages	1918	1919	1920	1918	1919	1920
Jan.	128.08	103.75	89.00	July	120.00	100.00
Feb.	118.00	90.00	.....	Aug.	120.00	103.00
Mch.	112.00	72.80	.....	Sept.	120.00	102.60
Apr.	115.00	73.12	.....	Oct.	120.00	86.00
May	110.00	84.80	.....	Nov.	120.00	78.00
June	112.00	94.40	.....	Dec.	115.00	95.00

MONEY AND EXCHANGE

In discussion of the new railroad law agreed upon by the House and Senate conference committees and likely to be enacted before March 1 without extensive changes, it has been assumed that the commission will use property accounts of carriers as test of their investment. The law leaves to the commission the determination of the investment, without specifying either the accounts of the carriers or the valuation process being conducted by a bureau of the commission and now approaching completion. Omission of any stated measure of valuation was not accidental. It was the purpose of the framers of the law to leave the commission free to use whatever measure of the investment value it saw fit and to reach its own conclusions from all evidence available. The result is that the commission will be in a position to make use of the partial results of valuation, at least as testing roughly the validity of the carriers' accounts, whereas if the law were to base the rate-making process expressly upon physical valuations to be found, it would be unworkable until these valuations had been completed or until they had been passed upon by the courts.

It is possible the commission will adopt aggregate book values of the properties in a given rate-making region as basis upon which to adjust rates and judge sufficiency of net revenues, pending the completion of valuation.

It is just this point that is likely to have an important bearing upon the much-discussed provision for the division of excess earnings of the stronger roads. Eventually, if not at once, the commission will have to adopt the official valuations of the respective carriers as the basis upon which to allow a free and undivided return of 6%. As roads of comparatively large net earnings are those of low capitalization and correspondingly low property accounts, they are necessarily the roads which will show up best in valuation. In other words, a road which appears to come under the profit-sharing provision of the law when judged by the returns on its property account may not do so when judged by the rate of return shown on the appraised value of its property.

As to the general rule according to which the commission is directed to adjust passenger and freight rates, it seems practically certain to afford more liberal revenues than the roads have had for the past ten or fifteen years. Assuming that in the aggregate the investment upon which a return of 5½% with a discretionary additional ½% for uncapitalized improvements is to be not less than the property account as of the present time, some idea of what it means may be gathered from the following record of the percentage return on the 'book cost of the property' for all the railroads of the United States:

Year ended:	%	Year ended:	%
Dec. 31, 1919.....	2.74	June 30, 1911.....	4.92
" 1918.....	3.76	" 1910.....	5.68
" 1917.....	5.32	" 1909.....	5.38
" 1916.....	5.96	" 1908.....	4.89
June 30, 1915.....	5.90	" 1907.....	5.61
" 1914.....	4.12	" 1906.....	5.58
" 1913.....	5.01	" 1905.....	5.10
" 1912.....	4.69	" 1904.....	4.83
		" 1903.....	5.19

Foreign quotations on February 24 are as follows:

Sterling, dollars: Cable	3.39½
" Demand	3.38½
Francs, cents: Cable	6.30
" Demand	5.87
Lire, cents: Cable	4.87
" Demand	1.15

Eastern Metal Market

New York, February 18.

All the markets are quiet to moderately active. The more stable conditions prevailing in foreign exchange have been a factor making for firmer prices.

Copper demand is light but prices are unchanged.

The tin market has been very quiet but fluctuations in prices have been less erratic.

Demand for lead is moderate and prices are, if anything, firmer.

Inquiry for zinc is better and quotations are slightly higher and firm.

Antimony has experienced a slight advance.

IRON AND STEEL

Insistent pressure from buyers, together with small stocks in the hands of consumers are the features of the market. The hand of cautious finance has shown itself in various ways. The volume of business has tapered off, due almost entirely to the refusal of mills to entertain orders. Price advances are still reported but this is not general. The trade is convinced apparently that, if a setback takes place, it will be of short duration. The January steel output, according to the American Iron and Steel Institute, was at the rate of 40,796,652 gross tons per year, or 84½% of the best rate in 1918 and probably 83½% of total capacity. February output will show a marked decline.

The Chicago district stands out in pig-iron buying activity. Prices of Eastern iron ore have been fixed to correspond with the recent Lake-ore advance of \$1 per ton. Railroad inquiries are developing. Car shortage is still a serious drawback. In tin-plate probably 1,000,000 boxes are piled in mill warehouses in Pittsburgh awaiting shipment.

COPPER

The market is exceedingly quiet but values are practically unchanged. After the heavy buying in December and early January interest in the market has materially subsided. So far as export business is concerned the exchange situation has eliminated it. The major or producers' market is quoted at 19c., New York, for electrolytic for early or first-quarter delivery with second quarter at 19.25c. For Lake copper ¼c. above these levels rules. In the outside market quotations as low as 18.50 to 18.75c., New York, for early-delivery electrolytic are noted, but not much metal is available. Producers are confidently looking forward to a more active market, both for domestic and foreign account, in the near future.

TIN

Consumers have been inclined to remain out of the market, which has been and is very quiet. Only a moderate amount of trading is reported, all in spot, with dealers the principal participants. It is evident from the course of the market that spot-supplies are being concentrated and that some strong interests are piling up reserves. Sellers who were pressing the market only a short time ago are not doing so now. On February 16 the market experienced its most active day of the week, there being a fairly brisk demand. Whether this resulted in much business or not is not definitely known yet, buyers in general being chary. Early that day spot Straits sold at 59.75c., but late in the day this position had declined to 59.25c. The following day spot Straits was quoted at 60c., New York. The more stable exchange situation has caused less unsettlement in prices here. There has been practically no business in future shipment. Arrivals thus far this month have been 2670 tons, of which only 150 tons is credited to Pacific ports. Tin afloat is reported as 5445 tons. The London market continues

strong, spot Straits having been quoted yesterday at £392 per ton.

LEAD

This market is very quiet, but if anything prices are firmer though actually unchanged at 8.75c., New York, or 8.50c., St. Louis, for both the leading interest and the outside market. The tendency in the latter is upward and some sellers are asking 8.80c. to 8.85c., New York, with spot strong at close at 9c., New York. Demand is light and requirements filled.

ZINC

This market while quiet is firmer, due to the steadier conditions in foreign exchange and to a better domestic inquiry. Both galvanizers and brass-makers are asking for early-delivery zinc and their demands have been fairly plentiful the last day or so. This has resulted in some business. Producers expect these consumers to be actively interested before long in metal for the second quarter. Prime Western for early and first-quarter delivery is quoted at 8.75c., St. Louis, or 9.10c., New York, the same price being quoted by some for April delivery.

ANTIMONY

The market is strong with wholesale lots for early delivery quoted at 11.62½c., New York, duty paid, against 11.50c. last week.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, for early delivery, are quoted from 31c. to 33c. per pound, New York, depending on the seller and delivery.

ORES

Tungsten: The Senate Finance Committee has taken action on the tariff matter. It has recommended that there be eliminated from the house bill the provision that there shall be levied on all tungsten or concentrates, that have been imported prior to the passage of the act, when such ore has been purchased at a price less than \$17 per unit of tungsten tri-oxide therein contained, a tax equal to the difference between the purchase price and that amount. The bill provides a duty of \$10 per unit on ores and concentrates and one of \$1.50 per pound of tungsten in high-speed and alloy steel and ferro-alloys.

Molybdenum: The market is quiet and quotations are quoted as purely nominal at 75c. per pound of MoS, in 90% concentrates.

Manganese: The market is strong with ore scarce and in demand, as high as \$1 per unit being asked for high-grade foreign ore.

Manganese-Iron Alloys: Carload lots of domestic ferro-manganese have sold up to \$180, delivered, over a period of 60 days. This contrasts with \$175 to \$185 paid for spot alloy. The market is strong, the preponderance of inquiry coming from those needing alloy for early or spot delivery, which is scarce. Domestic producers are asking \$160, delivered, for second-half and the relatively small amount of British alloy that is available, is held at not less than \$155, seaboard. Spiegeleisen is higher at \$57 to \$60, furnace. Sales of moderate amount of both alloys have been recently recorded.

Charles Hardy, Inc., of New York, states that while nominally quoted at \$80 per flask, quicksilver does not seem to be available at this figure and that there is no difficulty in obtaining a premium for spot delivery. The nominal quotation for chrome ore remains at 75c. per unit, with supplies for early deliveries very scarce.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 450 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MARCH 6, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	329

MR. HOOVER AND THE REPUBLICANS.....	330
-------------------------------------	-----

The letter that the President wrote before the Congressional elections in 1918 and Mr. Hoover's endorsement of it. What he said and what his action meant.

CONCERNING METAL QUOTATIONS	331
-----------------------------------	-----

Apropos of a letter in the 'Engineering & Mining Journal'. Has it a bias toward the metal merchants of New York? Its metal quotations and their aberrancy, as proved by comparison with the other McGraw-Hill publications. Absence of collusion is proved, also of accuracy.

HUMAN AND HUMANE	332
------------------------	-----

Comment on paper by Edward Higgins. A sincere and informing effort. How to combine economics with humanity, and exploitation with sentiment. Old methods at Butte. Educated men as shift-bosses. A square deal.

DISCUSSION

BLUE-SKY LAWS

By Geo. J. Bancroft.....	333
--------------------------	-----

Blue-Sky laws are often ineffective. Sometimes hinder men 'who can do things'. Should not interfere with legitimate enterprise.

BALL-MILL PRACTICE

By Paul T. Bruhl.....	333
-----------------------	-----

Exception taken to some conclusions of Curtis Lindley in recent article. 'Transferred energy' not an important element in crushing.

THE STATUS OF GOLD

By Thos. French	334
-----------------------	-----

Custom of the British mint in purchase of gold.

Rise in price of gold in England results from increased demand; not from fall in sterling exchange. Producers in United States may insist on a higher price. To Britain's advantage to increase the price.

PATENTS AND PROGRESS

By R. B. Brinsmade.....	335
-------------------------	-----

The problem is to encourage inventors without injuring society. Effects of patents on existent industry. Patent, a monopoly. Faults with our present patent laws. A possible cure. Right to collect royalties from exploiters. Merits of the scheme.

ARTICLES

THE BUNKER HILL ENTERPRISE—VI

By T. A. Rickard.....	337
-----------------------	-----

Former system of square-set stoping. Newly developed system. Approximately vertical back. Details. Development and exploration. Timbering skip-ways; raises; Kellogg adit. Underground fires. Method of handling. Breaking ground. Ventilation. Present condition of the mine is 'healthy'.

THE HUMAN ELEMENT IN MINE OPERATION

By Edwin Higgins	346
------------------------	-----

The humane method and the square deal. Foreman must know his men. Loyalty and co-operation. Responsibility and authority must lie together. Remove reasonable cause for dissatisfaction among the working crew. Safety work. Other considerations.

DEPARTMENTS

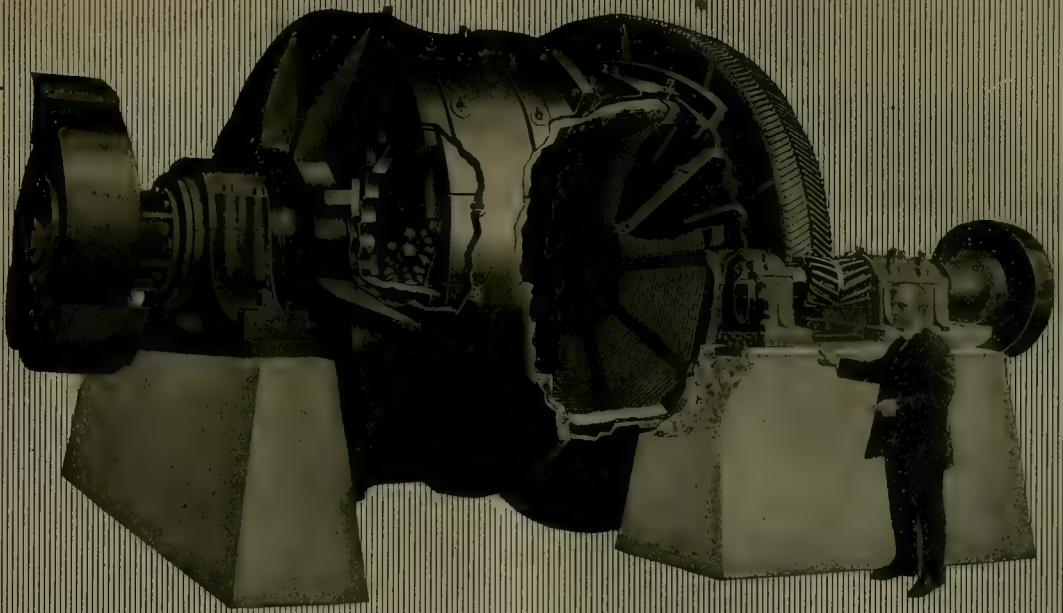
REVIEW OF MINING.....	349
THE MINING SUMMARY	357
PERSONAL	358
THE METAL MARKET	359
EASTERN METAL MARKET	360
INDUSTRIAL PROGRESS	361

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



Marcy Mills Are Made For Any Capacity Plant

[I]t is worth your while to investigate the Marcy "One Easy Step" method of ore reduction, even though your plant be small.

The same savings in crushing costs being made in large operations as at Inspiration, Braden and Kennecott, are possible in your own smaller mill.

The Marcy patented discharge is only one of many features which distinguish the "One Easy Step" method.

Literature describing the Marcy Mill best suited to your requirements will be sent if you will write an outline of conditions.

MARCY BALL MILL



The Mine and Smelter Supply Company

Denver

Salt Lake City

El Paso

New York Office: 42 Broadway

Headquarters for Mine, Mill and Smelter Equipment.
Large Stocks in Denver, Salt Lake City, El Paso.



T. A. RICKARD, . . . Editor

WE are requested to draw attention to a typographical error in the front-cover advertisement of the Dorr Company in our issue of February 14. The capacity of the 15-ft. Dorr bowl classifier at the Golden Cycle mill, at Cripple, Colorado, is 1300 tons daily, *not* 300 tons, as stated in the advertisement.

SIMP SPELLING has been rejected by the members of the Institute, we are glad to say. The recent vote went against the proposal brought forward by Mr. Shockley and his friends. We are glad of it, and hope now that, like good Americans, they will accept the vote of the majority and cease to trouble us further with their vagaries. Incidentally, is it too much to ask that the secretary of the local Section accept the decision of the Institute and drop sundry eccentricities of spelling that have annoyed many of us in San Francisco?

IN these days when the aftermath of war makes life so uncomfortable and perplexing, when the fruits of victory taste like Dead Sea apples, and the future is so overcast, we feel keen sympathy with the colored gentleman, wearing military uniform, who exclaimed: "I enlisted for the duration of the War, and the War am over, but I'se still in the Army." His comrade replied, "Yes, you 'listed for de War, and de War am over, but the duration am just beginnin'." It's the "duration" that hurts!

ONE week last month silver producers at Cobalt credited themselves with \$622,444 as proceeds from the sale of a trifle more than 400,000 oz. of fine metal; this being at the rate of approximately \$1.55 per ounce in Canadian currency. This exceptional price is calculated on the current American market quotation, and the coincidental premium of 15% on exchange at New York, where the financial part of these transactions is arranged. The identical bullion if marketed six years ago would have netted the vendors less than \$200,000. Incidentally, this particular shipment was consigned direct to the Orient, principally to China.

FROM the mines at Unsan, Korea, comes the report that the price of native foodstuffs and clothing continues to advance and that in consequence the management has increased the minimum wage to 50 sen per day, with a bonus of 10 sen per day for all miners who work 25 days or more during a month. Board and lodging cost 12 yen, so that a Korean who receives 15 yen per month

has a surplus of 3 yen, which is barely sufficient to buy shoes and clothing. One yen is equivalent to a half-dollar. We can understand how \$6 worth of rice will go a long way toward maintaining a tolerably full stomach, but it seems certain that the Korean taste in shoes, haberdashery, and tailoring cannot be exuberant. Mine managers at home may find some degree of consolation in learning that the difficulties arising from the increased cost of labor are paralleled in the remotest corners of the earth.

ON another page we tell of the measures taken by the mine operators of the Witwatersrand in forestalling disaffection among the native employees of the mines. A marked similarity between the difficulties experienced by the South African companies and those faced by operators in our own country is worthy of note. Self-appointed native leaders, too well educated to work themselves, agitate the mine-workers to a point where they feel abused; they demand more wages, and trouble follows. In this case, however, the Native Recruiting Corporation, which supplies the labor for many of the mines, solved the problem, for the time being at least, by calling a congress at Johannesburg of the native chiefs and headmen from all over the Transvaal. This meeting averted trouble temporarily, but the operators do not feel at all secure as to the duration of the settlement.

LAST week we outlined the main features of the Mineral Land Leasing Bill, which has in the interim been signed by the President and become law. At various places in Wyoming, Utah, and elsewhere there was some competition among engineers, who were on the spot waiting for official announcement that the Act was in effect, to be the first to post notices on particularly favorable areas. The law provides for a period of 30 days after posting during which application for permits to prospect may be filed. Some misapprehension prevails as to the character of the land that had been withdrawn and is now released. The impression that the territory is proved oil-land and that it is only necessary to get a permit, start a drilling-rig, and make arrangements to dispose of an assured output of crude oil is wrong. Much of the land thrown open is classed as 'doubtful' by the U. S. Geological Survey and most of the remainder, while bearing indications of the probable occurrence of oil, is undeveloped as yet. The Naval Reserve oil-lands in Wyoming and California, amounting to 100,000 acres, are not re-

leased for prospecting at the present time. The immediate result of the Act as far as oil is concerned probably will be an increase of from 3 to 5 million barrels in the annual production of Wyoming and a somewhat larger increase in that of California. An interesting fact in connection with the measure is the prominent position of Wyoming in respect of all the resources affected; this State rivals California in the extent and value of oil and gas lands released; it far outstrips all other States in the value of coal deposits affected by this Act and appraised by the Government; it has extensive oil-shale areas; and is second only to Idaho in the extent and richness of its phosphate deposits.

BRYAN is against Hoover; so is Boies Penrose; so is Sam Untermyer; and Hearst too, thank Heaven! Here are four good reasons for electing him! Three of these are Democratic, and we confess that we had cherished the hope that the Democrats would nominate him. Apparently this is unlikely if the machine has its way. Perhaps it won't. We note that Mr. Hoover declined to have his name filed as a Presidential candidate in the Georgian primaries and that he said: "I was not identified with the Democratic party before the War, and my official connection with the Government has been solely a war service, and consequently not of a partisan character." In short, he refuses to make any claim to the suffrage of the Democrats on account of anything he may have done as Food Administrator. He voted for McKinley and he supported Roosevelt ardently. Is he therefore a Republican? He may be; but not of the stand-pat or reactionary type. He is no more in accord with the old guard of one party than with the frothy element in the other. Shall we blame him? Are not most of us disgusted with the dominant elements of both parties, and are we not looking for a leader that will take us from the jungle of the emblematic elephant and the equally emblematic donkey into the open country of real statesmanship and genuine Americanism?

EXCHANGE has many facets. Recently the dollar was worth 6 shillings, instead of 4, in London, so that the 20 shillings in the pound was equivalent to 13½ shillings in New York, but at that time the pound was worth 39 shillings at Paris and nearly as much at Brussels, while at Rome its purchasing power was 31 shillings, and at Berlin as much as 325 shillings. No wonder, therefore, that great bargains could be made by buying things in Germany, although the authorities there have now insisted in certain cases on payment in the currency of the buyer. Gold went to 129 shillings and silver to 88 pence in London. To get the price in cents at normal exchange, multiply one by 25 and the other by 2. The Canadian government is paying for gold in New York exchange, thereby giving the Canadian miner a premium of 15%. The silver miner is equally benefited, so that he gets \$1.55 per ounce for his silver. Meanwhile our friends in South Africa are jubilant over the turn of events, which has had the effect of giving them a

premium of nearly 50% on their gold. We congratulate them; it was about time for a turn in their luck. India, South America, and even South Africa are buying gold in New York, the last making purchases for coinage, the previous gold coinage having been melted down owing to the premium offered on the metal. This illustrates the extraordinary condition of international monetary affairs.

Mr. Hoover and the Republicans

We have received a letter from a mining engineer at Los Angeles saying that he and his Republican friends would like to know "whether Mr. Hoover at one time came out with an announcement to the effect that Democratic congressmen should be returned to Congress in support of the President." The facts are these. On October 28, 1918, on the eve of the Congressional elections, President Wilson made an appeal to his "fellow-countrymen". He said: "If you have approved of my leadership and wish me to continue to be your unembarrassed spokesman in affairs at home and abroad, I earnestly beg that you will express yourselves unmistakably to that effect by returning a Democratic majority to both the Senate and the House of Representatives." The President proceeded to declare that although no party had a monopoly of patriotism, "a Republican Congress would divide the leadership", because the Republican leaders, even though they had been for the War, had been opposed to his administration. "At almost every turn since we entered the war, they have sought to take the choice of policy and the conduct of the war out of my hands. . . . The return of a Republican majority to either house of the Congress would, moreover, be interpreted on the other side of the water as a repudiation of my leadership." The country did return a Republican majority to both houses of Congress and the leadership of Mr. Wilson was repudiated, unfortunately for him personally and unfortunately for issues even bigger than his personal prestige. Although the election went against him, he went back to Paris and entered into a number of engagements with the representatives of other countries, engagements that he has been unable to make good because the Senate has declined to confirm them. He did not receive the vote of confidence for which he asked, the European leaders did not realize the fact sufficiently, and the consequence is that they made a peace on terms that their national legislatures ratified, but the American Senate did not, so that the efforts to arrive at a post-war settlement of international affairs have lapsed into bewilderment and confusion. But what did Mr. Hoover say? He is nothing if not loyal. He had become a member of the President's official family, as it were. He was invited to support the President in his appeal to the electorate, and he did not hesitate to do so, although manifestly it was poor politics, as politics are understood by the mere politician. He wrote: "My own views are summarized in a word—that we must have united support for the President. In the issues before us there can be no party politics. It is vital that we have a united

front and a sustained leadership." In short, he did not second the partisan appeal of the President, but he did ask the people to give the Chief Executive the expression of support he required for the performance of his work as their representative at Paris. The Armistice was not then assured; the end of the War seemed near, but there was much to be done; it appeared necessary to back the President during the remainder of the War and in the impending negotiations for peace. We say deliberately, no matter how repellant the egoism and vanity of Mr. Wilson may be, and however great his manifest failure to rise to a superb opportunity, that it would have been better, for our own country and for the world at large, if the President had received the support of a friendly majority in Congress, and therefore we accept Mr. Hoover's action as evidence of a fine personal loyalty and a large patriotic sagacity.

Concerning Metal Quotations

"Bang! went the boy-scout's trusty rifle, and the redskin jumped fifty feet into the air, never to come down again." Please excuse this echo from our school-boy's reading; it is prompted by a similar outburst, introducing a letter in a recent issue of our contemporary in New York. It appears that Mr. P. B. McDonald wrote to the 'Engineering and Mining Journal' conveying his compliments on the "nerve" of the New York paper in expressing "surprise that anyone should have the impression that the 'E. & M. J.' is 'allied with Wall Street and the Trusts' ". This last phrase is quoted from our contemporary's issue of February 7. Mr. McDonald's letter is not printed under the heading he expected but under a humorous reference to the redskin of dime romance. That was funny, whereas Mr. McDonald evidently was very serious in attacking the 'E. & M. J.' for "a certain reactionary and capitalistic aloofness" and for its "obvious bias" toward malefactors of great wealth. We are glad he did not send the letter to us for publication, because we, of course, could not have allowed anything so unkind to be printed in our pages, however much we might be in accord with Mr. McDonald. Indeed, while we do not believe that the 'E. & M. J.' is the tool of the 'trusts', even the smelter trust, or of any other bold bad people, we do think that our contemporary feels the influence of propinquity. It is only human to be friends with your neighbors. Environment counts more heavily than heredity. A spirit friendly to its neighbors at 120 Broadway pervades the editorial on the metal market appearing in the issue that contains Mr. McDonald's letter. Our contemporary sighs to transfer "the burden of being the quoter of the most reliable figures" on metal prices to an exchange or some other old thing. The job is so tough. We sympathize with the editor, for it is extremely unlikely that anybody will do the statistical guessing even as well as Mr. Ingalls, who recently retired from the editorship and who gave so much of his time to this unpleasant task. The distinguished geologist who is now editor says that "a public

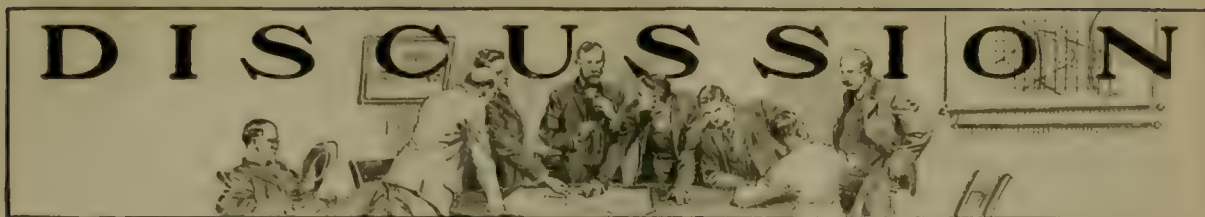
exchange would mean the turning over of the metal industry to middlemen and speculators . . . it would mean corners and combinations by influences unseen and unknown, and therefore the skinning and starving of the producer and the consumer alike, for the better clothing and fattening of the parasitic class". Too many words, Mr. Editor. As if combinations did not now establish the quotations for the base metals and as if the alliterative ill treatment of the small producer was not now a matter of personal knowledge and public resentment. The gentleman in New York has detected no signs of displeasure among the miners; it is true, complaints are made by the farmers, but not by those engaged in mining; there contentment reigns. "In the mining industry we hear little or nothing of real or fictitious Bolshevism", says he, because "the metal industries are, in part at least, on an ideal and bedrock basis, which even the Socialists could hardly show us how to improve." Then in the name of sincerity who has been writing those Hearst-like vapors on Bolshevism that have appeared in large print across the upper half of the first editorial page of the 'Engineering and Mining Journal'? Indeed, Mr. McDonald did bring down something that looks like a cigar Indian. The self-complacency of the 'Engineering and Mining Journal' over its metal quotations is amusing, having regard to its own ingenuous confession, appearing in the issue of February 7. Let us quote the paragraph to which Mr. McDonald refers: "We have encountered a certain feeling that the McGraw-Hill Publishing Co., which publishes the *Engineering and Mining Journal* and ten other publications, and which, through its allied company, the McGraw-Hill Book Co., is the largest publisher of technical books in New York, is allied with 'Wall Street and the Trusts', and that the metal quotations of this company are controlled by the great metal-producing companies." What the number of publications, even though it be so overpowering as eleven, has to do with the accuracy of metal quotations, we do not know. However, it throws a light upon their discrepancies, as we are duly informed, for the editor of one of them proceeds to show how his unimpeachable statistics differ from those given by the other editors of this journalistic phalanx. Let us quote him again: "We find that, of three of the technical journals published by the McGraw-Hill company, the *Engineering and Mining Journal*, *Chemical and Metallurgical Engineering*, and the *Electrical World*, all of which publish New York metal quotations weekly, no two agree. For example, on Jan. 6, the *Electrical World* quoted copper 19@19½c. and tin 63.25c. On the same day the *Engineering and Mining Journal* quoted copper 18.85@19.10c., and tin 61½c. *Chemical and Metallurgical Engineering* on Jan. 5 quoted copper 19½c., lead 8.00c., zinc, East St. Louis, 9.27½c., and on the same day the *Engineering and Mining Journal* quoted copper 18.85@19.10c., New York lead 8.45@8.55c., and zinc, East St. Louis, 9.35c. Comparisons on other dates are correspondingly dissimilar in nearly all cases." In short, the 'E. & M. J.' quotations for copper, lead, and tin differed by ⅔, ½, 1¼ cents

per pound, respectively, from those appearing on the same day in other papers owned by the same syndicate. The editor proceeds to say: "Certainly we must exonerate the McGraw-Hill company of systematic collusion with anything or anybody, even with itself, in the past; but in the future 'The Journal' will try to secure a greater uniformity of metal quotations among those different journals at least." By all means, gentlemen, get together! We exonerate you of systematic collusion, and we acquit you of systematic accuracy.

Human and Humane

In this issue we publish the text of a paper read last week before the local section of the Institute by Mr. Edwin Higgins. The subject was the treatment of employees at mines and mills; it may be termed the human or humane aspect of mine economics. Mr. Higgins is well qualified to discuss this important matter, for to careful observation he joins the sincerity without which no discussion on vital matters is worth while. He was addressing mining engineers, therefore he discussed the attitude of the employer; naturally, if he had been talking to employees he would not have laid so much emphasis on the idea of getting more out of the men. One of the subsequent speakers suggested that whereas the engineer used his skill in exploiting valuable natural resources, he failed to exploit the resources most valuable to industry, namely, man. Another dwelt eloquently on schemes for making the men comfortable and happy. Those are the ways, of course, that discussion on the subject usually goes. Both are unlikely to fulfil their purpose. No man likes to think of himself as being exploited for the benefit of others; much of the so-called welfare work fails simply because the objects of it become self-conscious, they resent the idea of being bamboozled by kindness into becoming more effective machines for money-making by capitalists; they detect the cant that lurks in much of the pseudo-philanthropy of captains of industry. On the other hand, the Sunday-school sentiments of some managers and superintendents are hardly less liked than the frank commercializing of beneficence; it is obvious to anyone but a fool that the object of mining is to make money, not to give men reading-rooms or shower-baths; the purpose is to turn ore into dollars, not to Americanize aliens or placate potential I. W. Ws. An owner that heard the superintendent of his mine protesting that he was only running the mine in order to render the community happy would be wise in ridding himself of a representative that was either a knave or a chump. Let us shed all sloppy sentiment and come to realities. The purpose of mining is to make money; how can it be done humanely but effectively? How can we set aside the crude idea of exploiting men as if they were machines and yet avoid insincerities concerning our purpose in paying proper regard to their health and contentment? We think it can be done by aiming to win their loyalty; loyalty from them ensures co-operation and honest labor; loyalty to them will prompt regard for their well-being; the loyalty must be mutual. If the manager endeavors to

cultivate a spirit of loyalty in his men, he will get all the rest for which he aims. Loyalty calls for continuity of employment. The curse of mine labor is its intermittence; intervals of idleness dissipate the small savings that the miner makes; they incite migration, which is costly. To develop loyalty it is necessary to retain men long enough to become well acquainted with them and to cause them to feel themselves a part of the mine community. That suggests some scheme of housing such as will cause a good type of men to take domestic root in the locality. The appreciation of good service will lead the management to take an interest in the lives of its employees and therefore to provide for them, preferably indirectly, facilities for recreation. Above everything, the suggestion of patronage must be shunned. It is best to let the men take the initiative and then assist them. For that purpose workmen's committees are useful, for they render the employees articulate, thereby creating a link of communication that will go far in assisting a mutual-ity of understanding. The short life of many mines prevents the development of any systematic policy, but, on the other hand, the smallness of a mine affords a closer contact between manager and men than is possible in the big enterprises, which suffer the penalty of their bigness, namely, the delegation of authority to many subordinates and the necessary indirection of an elaborate organization. The choice of shift-bosses is important. Tough Irishmen armed with pick-handles might serve Marcus Daly in the early days of Butte, but all that ignorant brutality is out of date. Today college graduates possessed of a physique strong enough to go through the apprenticeship of drilling, shoveling, and timbering, make the best shift-bosses. Until a man has felt the pain between his shoulder-blades that comes of manual toil, he is not in a position to understand the toiler; to have done the work himself makes a man a fairer judge of another man's work. Educated men treat the uneducated better than their own kind; there is more humanity, as well as more intelligence, in a graduate of Berkeley or Houghton than in one of Daly's Hibernians. Another suggestion: many a mine has had labor troubles on account of its boarding-house or its store. Don't sacrifice the economics of a mine to the profiteering of the boarding-house or to the gain from store-keeping. Neither of them should be a source of profit; both of them should be conveniences conducive to contentment. To feed workmen inadequately or unwholesomely is as foolish as to send waste to the mill; to run a store in order to get back a part of the men's wages is no wiser than making a rich tailing for the sake of re-treatment. In all these relationships of man to man there must be an ideal of fair play—of the 'square deal' as Mr. Higgins says. It is not easy to establish it among a migratory and an alien proletariat, such as has replaced the labor of an earlier day; but it is at least a satisfaction to a good American to remember that if he succeed in establishing that ideal of fair dealing, and then of loyalty, he will be assisting the great process of Americanization on which the welfare of this republic must rest.



Blue-Sky Laws

The Editor:

Sir—Regarding wild-cats and Blue-Sky laws: It is most desirable to prevent fraud, and any law that will effectively prevent fraud is one which all good men will support, regardless of the cost of administering such a law. The main opposition to Blue Sky laws springs from the feeling that they do not prevent fraud, and, on the other hand, it is admitted that they are a burden upon legitimate industry.

There is a good deal of basis for this feeling. I think it was Solomon who said "A fool and his money are soon parted." Solomon was a wise ruler, but he evidently could devise no law that would prevent a fool from parting with his money. It does not yet appear that our modern law-makers have accomplished what Solomon failed to do. I have operated in several States having very rigid Blue Sky laws, but have never observed that a fool had any more trouble in parting with his money under Blue Sky regulations than without such regulations.

Consider the matter from the standpoint of the 'wild-catter'. Let us imagine, Mr. Editor, for the sake of argument, that you and I are accomplished 'con.' men, and that we are planning a line of activity. To what extent will a Blue Sky law retard us? Now I venture to say there are ten thousand avenues of industry open to our refined talents, and a Blue Sky law has to do with only one of these avenues. It does not even block that one. By carefully studying the law, we may twist it to our nefarious uses. I have seen it done. The point that I wish to make is that Blue Sky laws, at best, make only one strong panel in a fence that must have ten thousand such panels if it is to be effective against 'wild-cats'.

Blue Sky laws, together with a large proportion of the laws inspired by our modern reformers, are a nuisance and an irritation to the man 'who can do things'. By far the most serious strike that is in progress today is the silent strike of the men 'who can do things'. The big men are quitting. They have no union and no loud-mouthed walking delegates, but they are quietly winding up their affairs and dropping their tools. I see it wherever I go. Our captains of industry have been harassed with legislation, political dictation, red tape, arbitrary taxation of effort, as well as of money, until the incentive to intense individual effort is gone. To my mind no strike of recent times is half so portentous as the unheralded strike of the men 'who can do things'.

Is it not about time to give some thought and attention

to the "working conditions", the "hours of labor", and "healthful recreation" of our captains of industry, when so much thought and attention is bestowed on these subjects in connection with day's-pay men? So in framing, amending, or administering Blue Sky laws it seems to me that it should be borne in mind that at best such laws can do very little good, and, hence, they should work as little bother to the legitimate operator as is possible.

An old mining friend of mine was discussing the matter in a whimsical vein the other day. He said: "I see these self-righteous mining journals are hopping on the poor cuss that sells a share of stock again. I once had a friend over in Utah; he had a good little mine, and he read in one of these righteous journals the advertisement of a man that manufactured a wonderful mill. It was four times as good as any other mill on the market. The advertisement in this righteous journal used these very words. So my friend went out and sold some stock to buy and erect one of these wonderful mills. When the mill was erected, it proved an absolute failure; and then this very righteous journal, which through its advertising columns had induced my friend to buy this fraudulent mill, turned right around and denounced him as a wild-catter, and a shyster for having sold stock to buy the mill. It appears like there is a lot of people terribly interested in protecting the dear public from the miner but nobody is interested in protecting the miner from the dear public."

I quote the above as an illustration of just one of the ten thousand ways of getting money fraudulently without the use of stock certificates.

GEO. J. BANCROFT.

Denver, February 15.

Ball-Mill Practice

The Editor:

Sir—A perusal of Mr. Curtis Lindley's article on this subject leaves me unconvinced that the major portion of the crushing in a ball-mill is performed by transferred forces. Let us assume that a ball-mill has a capacity of 100 tons per 24 hours under ideal conditions, that we wish to crush that amount, but that through inexperience we do not maintain the correct pulp-density. If the feed be too 'thin', the passage of solid particles through the mill is too rapid; therefore the chances for any individual particle to be hit are lessened. I do not think Mr. Lindley's idea that crushing is adversely affected in a thin pulp owing to the outward-moving currents induced by the approach of two bodies is entirely correct, because the

contents of a revolving ball-mill are in a state of great confusion and there are many interfering currents. The mill-duty falls solely because the ore does not remain long enough in the mill. On the other hand, if the feed be too 'thick', the mill-duty is soon impaired by the coarseness of the discharge. Passage through the mill is slower, chances for any one particle to receive a blow are better, yet the crushing is not as fine as it ought to be. This is due to the cushioning effect of a thick pulp. Given two mills, one loaded with spherical steel balls, the other with quartz of like shape (I assume a quartz sphere for purpose of illustration only), we find that the former will handle a denser pulp and, of course, a larger tonnage. This makes clear that an important factor in crushing is the specific gravity of the crushing medium. Mr. Lindley does not think that more than 5% of the crushing is done by direct impact. I wonder whether he will find much support for this view. The assumption that the greater part of the crushing is done by transferred energy appears to be reasonable only in the case where a heavy ball falls on a number of small ones. When a ball falls on a stack of balls temporarily at rest with respect to one another, in a revolving mill, the energy not dissipated as heat is transmitted to all points of contact. It is easy to imagine the insignificant amount of energy at any but the highest points of contact. Many of us have heard of the old-time showman who permitted an iron ball which he placed on his head to be struck by a heavy hammer. It seems to me that the major portion of the crushing in a mill is done by the clashing of moving balls, whether the movement be roughly perpendicular or lateral.

PAUL T. BRUHL.

Thomson, Georgia, February 19.

The Status of Gold

The Editor:

Sir—I have followed the discussions of the gold and money problems in your paper with great interest, and it appears to me that certain usages in England with regard to currency and coinage have not been referred to in these discussions, and perhaps they are not properly understood in America.

In Britain, any person having a certain quantity of gold, is entitled to send it to the Mint, where it will be assayed and coined, and the same amount of pure gold will be returned to him in coins of standard fineness, without any charge whatever, the Government bearing all wastage and other losses. Gold is therefore coined at a loss to the Government. On the other hand, silver and copper are also coined, at a profit that more than covers the loss in the coining of gold. Furthermore, the British government has not set any value on these gold coins. It has called a certain weight of gold of standard fineness, a 'sovereign', and has said that 20 shillings is equivalent to a sovereign, but that more than 40 shillings is not legal tender in settling a debt.

Many have suggested that the respective governments should raise the price of gold, from approximately 85

shillings per ounce of pure gold, in England, and 20.67 dollars in the United States, to a higher figure, apparently forgetting, or not realizing, that shillings and dollars are only the equivalents of a certain weight of gold. They have not realized that coined gold is simply a commodity, that is, subject to the laws of supply and demand, like any other commodity. They have probably been misled through the practice in England, of selling most of the gold to the Bank of England, which gives in return sovereigns or bank-notes equivalent to about 85 shillings per ounce of pure gold, exacting only a very small commission, thus saving the customer the delay in connection with the coining of his gold. That the British authorities are well aware of these facts is shown by their having made an arrangement with the principal gold producers to sell all their gold output during the War through the Bank of England at the rate of 85 shillings per ounce for patriotic reasons.

At the present time, bar gold is sold in England at 120 to 130 shillings per ounce. There is a general opinion that this rise in the market value of gold is the direct result of the fall of sterling exchange. From this opinion I venture to dissent. The rise in the market price of gold is the direct result of the demand for gold, probably encouraged by the British government.

To understand what the rise in the market value of gold means to Britain, it may be well to follow in a simple way what happens when a British producer sells his gold. It is produced in a British possession by British capital and costs for its production, say, £4.25 per ounce. It is sold or exchanged in England, in the best market, and for this gold the producer now demands between £6 and £6.5 per ounce, either in gold sovereigns, or their equivalent in other goods. The British public must have gold, and to get it they must now give at least 6 sovereigns for the same weight of gold for which they previously gave 4½ sovereigns. It certainly does appear at first sight to be somewhat paradoxical, to buy 4½ sovereigns with 6 sovereigns, but when it is considered that as soon as the transaction is completed, the 4½ sovereigns at once becomes of the value of 6 sovereigns, the anomaly disappears. Not only that, for the market value of all the nation's stock of gold is raised from 4½ to the new standard of 6. The appreciation in the value of the sovereign will only be limited by the demand for gold and there is no saying where it may stop. This rise in the value of gold costs the British nation nothing, for the increase is merely paid by one member of the family to another member, and at the worst it is only robbing an English Peter to pay an English Paul.

British capital controls over 60% of the gold output of the world. According to Mr. Lindgren, the whole of the United States production is used for industrial purposes. As soon as the United States producers can be made to understand that their government must have gold, with the example of Britain before them, they will insist on being paid a higher price for it. If the United States must buy gold from external sources, it will probably have to pay the British price for it, and we may

therefore confidently expect that the price of gold in America will approximate to the price in Britain. This means a great deal to Britain, for its debt to the United States was contracted on a basis of 85 shillings or \$20.67 per ounce of gold. If the price of gold in the United States becomes 130 shillings, for instance, Britain's debt of, say, eight and a half billion dollars would be at once reduced to about five and a half billions, and if Britain can force the price still higher, which she may be in a position to do, she will benefit to a still greater degree, at the expense of every other nation.

There are other inducements for Britain to raise the value of gold throughout the world. Its labor costs are much higher than previously, but as they cannot now be very far from the zenith they will probably not be much affected by an appreciation in the value of gold. On the other hand, if the United States must import gold at a higher price, its labor costs will probably continue to rise for a long time. In any case, America is much handicapped by long haulage and high freight-rates, and if the latter are raised, wages generally must be raised also. If labor costs in America continue to rise, Britain will once more be placed in its former advantageous position, as regards its ability to export its manufactures at a profitable rate, and so may re-gain, in course of time, its proud position as financier of the world.

THOS. FRENCH.

Toronto, February 20.

Patents and Progress

The Editor:

Sir—With much of Mr. Greenawalt's recent article on this subject I am in hearty accord. Nevertheless, as there are some phases of patent law where Mr. Greenawalt's views seem inadequate, a few remarks covering these omissions may be pertinent.

If Mr. Greenawalt had used the terms 'Socialism' and 'Bolshevism' more concisely his meaning would have been clearer. Politically, 'Socialism' may be defined as the public ownership of all means of production, and 'Bolshevism' as socialism put in practice on a communistic basis. But much of what Mr. Greenawalt calls socialism—such as a doctor devoting his life without pecuniary reward to find a cure for tuberculosis—is not political socialism at all, but that unselfish co-operation of individuals for social purposes which has raised mankind from savagery to civilization. On my first visit to Santo Domingo, I was startled by the lack of such public utilities as municipal water and sewer systems or rural wagon-roads and bridges. At the start I was unable to explain this defect in an apparently intelligent population occupying a fertile country, but it soon developed that the cause lay in the extreme selfishness of the people. As the citizens refused to contribute any time or money whatever for social purposes knowingly, all the public revenue had to be collected surreptitiously by custom dues and similar indirect taxation on consumption. Until, therefore, the Santo Domingans learn to modify

their savage individualism in favor of unselfish co-operation for social ends, they can never hope to pass from barbarism into civilization.

Granting that there is really no basic invention and that the best anyone can do is to cap and complete a structure of devices and ideas left by his predecessors, the problem becomes how to encourage inventors without injuring society. It is evident that Mr. Greenawalt's proposal to establish public laboratories, where would-be inventors may test their ideas, would be beneficial up to the point where it attracted attention as a source of political pork. The arbitrary period of 17 years for the life of an American patent is meant to protect the public from a possible undue mulcting by the patentee. Sometimes this period is too short to enable the inventor to perfect his idea, as Mr. Greenawalt points out; sometimes it is long enough to create huge fortunes for various individual monopolists, among whom the inventor himself is rarely included. There seems no reason to oppose the extension of the life of a patent to that of its inventor, provided only that property in patents be modified in its nature.

And just here enters a practical condition of which Mr. Greenawalt has failed to take note, namely, the effect of a patent grant on existing industries. The grant that means a rich reward for its owner may imply appalling losses to many established trades. For instance, any invention that renders obsolete the previous devices for the same purpose will destroy the business of the makers of the latter unless they can obtain a license for its manufacture. Under present laws this is quite liable to happen, for the inventor can restrict his license to a single factory and that a new one. This is certainly unfair to established interests and quite unessential as a means for rewarding the inventor; in fact, it has often the opposite effect, for the established factories, driven to the wall, begin to 'infringe' the new patent, and then begins the long struggle of the inventor against the piratical litigation so well described by Mr. Greenawalt. In such cases, there seem only two alternatives for the poor inventor; either to be intimidated into selling his patent "for a nominal sum through a forced compromise", or else jump down the throat of some kind capitalistic whale, who, in return for legal defence, will want the lion's share of the proceeds.

Technically, a patent is a monopoly, despite Mr. Greenawalt's opinion to the contrary. A monopoly does not consist necessarily in the complete control of a certain commodity, so as to fix its price, but the exclusive possession of any means of producing the commodity that is not open to all on equal terms. Our present patent laws go even further than a mere grant for monopolizing the use and sale of one invention, because, according to the decision of the Supreme Court in the trial of the United States Shoe Machinery Co., a patentee is legally empowered to refuse to allow his devices to be used in connection with the inventions of others, or in the utilization of any unauthorized accessories.

Mr. Greenawalt remarks: "Manifestly, royalties or compensation that would be satisfactory to the inventor

would not meet the demands of a heavily capitalized company, and if a royalty charge is made to meet all conditions, the royalties must, necessarily, be large . . . If the royalties are excessive, no fault should be found with the inventor; and no fault should be found with the companies controlling the patents, for they are doing what other companies do under similar conditions." He may be right from the standpoint of those monopolistic manufacturers and their inventive protégés, who act on the motto 'the public be damned'. Nevertheless, the public is gradually finding itself economically in the United States and some day may refuse to be longer mulcted of excessive royalties simply for lack of equitable patent laws.

To sum up, there are seven weighty objections to our patent grants in their present form: (1) They grant a manufacturing and selling monopoly that is out of harmony with our competitive industrial system; (2) They may disturb, injure, and even ruin legitimate established trades; (3) They cause a vast amount of needless litigation; (4) They tend to benefit the capitalist at the expense of the inventor; (5) They fix no limit as to what the public must pay for the use of an invention; (6) They fix no penalty for failure to use an invention; (7) They enable the owner of one invention, as a prerequisite to its use, to prescribe the boycott on other inventions.

As a remedy for all these defects, many thinkers—such as the late Tom L. Johnson of Cleveland—have advocated the abolition of patents altogether. This might be good policy for a backward nation like Mexico, which has practically no native inventors and seems unlikely to develop any in the predicable future; but for progressive countries such a remedy would be worse than the disease. The lack of legal protection for their achievements would keep many persons from inventing, while the remainder would be forced to exploit their inventions in secret in order to profit by them. We would then have a recession to the medieval days of secret processes and of 'lost arts', because in ancient times a device could perish with its inventor.

Abolition being inadvisable, is a cure of the grave faults in our existing patent system feasible? I would reply affirmatively, provided the nature of the grants be altered. Instead of giving a patentee the right to monopolize his invention, let the grant merely recognize his right of property to the extent of permitting him to collect royalty from its exploiters. The New Zealand law, I understand, is based on this principle and allows anyone to make or use an invention on condition of paying a toll to the patentee. In case the latter is unreasonable in his demands, the rate of toll will be fixed by the courts. This may be what Mr. Greenawalt derides as 'Socialism', but in my humble opinion it is merely a rational application of that socialization which differentiates civilization from barbarism—the restraint of individual greed and caprice for the common good.

If we scrutinize the seven enumerated defects in the light of the proposed changes, we discover at once that both objections No. 1 and 2 disappear, for anyone can

then make and sell the new invention, while established trades can freely add it to their existing stock of goods. Thus much of the incentive to litigation would be eliminated, because the established interests, no longer threatened with loss by being excluded from making or selling the new device, would find it cheaper to pay the patentee his toll than to pirate his ideas at the risk of costly lawsuits. The need of little or no funds for legal battles would save the inventor from falling a prey to the grasping capitalist, while the public would be protected from the excessive royalties by the power of the courts to limit them. An invention, once patented, could be used legally by anyone, so nothing of value would be withheld from society; and, for the same reason, the power of one patentee to force a boycott on another's devices would be abolished.

On the new basis, it would be advisable to extend the duration of a patent to the death of its inventor. Such an extension could work no harm to the public, whereas it would stimulate invention by giving inventors both plenty of time to perfect their devices and to enjoy the reward after the perfection. If it be objected that no capitalist would subsidize an inventor when he could no longer obtain a monopoly, it suffices to say that he then could expect to obtain his reward as now from a share of the royalties. When the inventor's royalty came before the court for approval, the judge would always consider the cost incurred in developing the invention before giving his decision as to its reasonableness. While fewer patent lawyers would be opulent and fewer capitalists might enter the millionaire class under the new system, there would certainly ensue less risk of loss and surer rewards for the inventors, and, consequently, many more inventions of practical utility.

Whether our patent law is altered in principle or not, I support Mr. Greenawalt in his advocacy of a more scientific administration. Perhaps now that the Great War has convinced even a lawyer of the value of applied science in destruction, there may be a better chance for scientific men to receive some recognition in the law-courts and legislative halls for the constructive arts of peace. Up to date our patent trials have borne a close resemblance to those involving the mining rights under the Federal law of the apex, and both have often resulted in sad parodies of justice, and even of common sense, for lack of judges trained in technology.

R. B. BRINSMADE.

Ixmiquilpan, Mexico, December 30.

PRACTICALLY all tungsten ore now produced in the world is used in making tungsten metal or ferro-tungsten. Various salts of tungsten have been employed in the dye industries, but have been almost wholly replaced by cheaper chemicals. Over 95% of the tungsten production goes into the making of tungsten steel, which is in general use for high-speed cutting tools, permanent magnets, and saw blades. A small amount of nearly pure tungsten is consumed in making filaments for incandescent electric lights.

The Bunker Hill Enterprise—VI

Methods of Mining and Exploration; Fires Underground

By T. A. RICKARD

Skilful mining involves the adaptation of methods to conditions. In the course of the development of the Bunker Hill mine from a young prospect to a big mine, it has been found advisable, by those in charge, to make radical changes in the manner of winning the ore, that is, of breaking it and collecting it before removal to the surface. These changes have been rendered necessary, to some extent, by the increase in the width of the excavations made underground, this increase being due in part to the discovery of larger orebodies, but in part also to the change in economic conditions above-ground, notably in the mill and metal-market, whereby it has become advantageous to remove a larger width of lode-matter, that is, to extract material that by reason of better technical conditions has come within the economic limit of profitable exploitation.*

In the early days of the mine 'the ground was carried', or the wall-rock was sustained, by stulls and half-sets, supplemented by a small amount of filling, the timbers being loaded with waste so as to cushion them and prevent damage from falls of rock. When the stopes became larger, more particularly on the Bunker Hill side of Milo gulch, beginning in 1897, it became the custom to use full sets, together with an increased and better distributed proportion of filling. As is usual when employing this type of timbering, the back of the stope was kept nearly horizontal and there was no pronounced arching, so that the hanging wall, often extremely heavy, was supported entirely by timbers until the filling was placed against it. By the time this was done, at least two weeks had elapsed, the ground had begun to weigh so heavily upon the timbers as to crush them, and big slabs of rock had fallen from the hanging wall. See Fig. 1.

During this period the drift used for the removal of the ore was on the sill-floor, where it was subject to the pressure and squeezing of the mass of waste-rock settling down in the stope. Costly repairs were rendered continuously necessary in order to make room for the ore-cars and prevent obstruction to the tramming. Furthermore, the timbers and supplies needed in the stopes came down through raises on the foot-wall, which was a position most inconvenient for the distribution of materials over the large area occupied by the stopes. Several accidents occurred. They were not calamitous, but on top of other reasons, already stated, they were quite serious enough to call for a modification of this method of mining.

*For the data used in this article I am indebted, as will readily be surmised, to Stanley A. Easton, the manager.

Here I may suggest that the 'square set' system of timbering, together with the scheme of stoping that it involved, was thought a wonderful innovation twenty or thirty years ago. The Western miner prided himself on it and introduced it in foreign districts, such as Broken Hill and Kalgoorlie. It was 'invented', or, more correctly, introduced, by Philip Deidesheimer† on the Comstock in 1860 and was heralded as a great improvement. During the last twenty years the use of the 'square set'

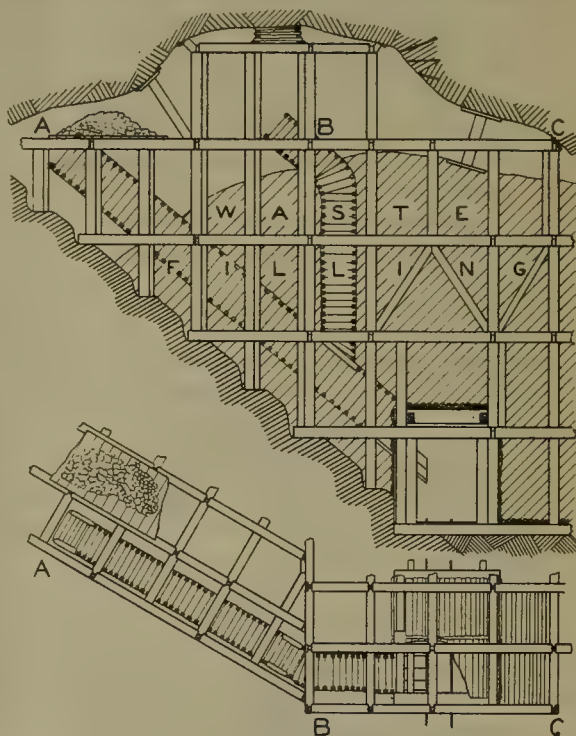


FIG. 1. FORMER SYSTEM OF MINING

without filling has gone out of fashion because it has been found a snare and a delusion. The idea it embodies is that of a carpenter rather than of a miner. The unrestricted use of it has led to big caving and the destructive collapse of mines in various parts of the world. No timbering by itself will support heavy ground; it will only delay a fall. To sustain rock it is necessary to use rock. Therefore all recent systems of mining involve the use of waste to fill stopes and the leaving of pillars of ground to sustain a heavy hanging wall.

†He died in San Francisco in 1916.

In 1904 the method of mining in the Bunker Hill began to undergo change and in the course of two or three years it was developed into the system now in use, as shown in the plan and section in Fig. 2 and 3.† The important features of this system are as follows:

1. A nearly vertical exposure of ore at the working face, instead of a horizontal or flat face as formerly. This permits the drilling of 'uppers' made by stoping-drills, instead of the slightly inclined 'water holes' of the old system. The broken ore falls toward the mouth of chutes placed on the foot-wall, and much of it passes by gravity direct into these chutes, diminishing the need for shoveling. Formerly the ore fell on platforms spread over the square sets, so that all of it had to be shoveled into a chute or into wheelbarrows. By the new method the ore falls continuously toward the chutes.

2. The ground is excavated in the form of a sharp arch, the crest of which is the intersection of the face of ore with the plane of the hanging wall. This utilizes the full strength of both ore and wall for maintaining the stope-cavity. Waste is introduced at the crest of the arch and distributed laterally over the stope by hand-tramming in small dump-cars running on a temporary track. The waste, so introduced, passes by gravity to any place where filling is needed, without further handling. In order to hasten the settling of the waste, it is usually wetted, by a spray or other means. When drained, it consolidates almost like concrete; all voids are filled immediately, particularly those against the hanging. Not only does this filling, thus carefully distributed, serve to support the hanging wall, but it excludes the air and checks any tendency of the hanging wall to crumble or break. Timbers needed in the stopes are handled in the same way as the waste, that is, they are trammed along the crest of the stope, and brought to their place of use with the minimum of labor.

3. Permanent haulage-ways are extended along the main level, at the foot of the stope, for disposal of the ore. Bottom-dump cars of special design and of 1½ tons capacity are used in harness with storage-battery locomotives. This foot-wall drift or permanent haulage-way is connected with the chutes in the stope proper by means of rock chutes (that is, chutes excavated in the rock) provided with steel lips for facilitating discharge. These rock chutes serve not only as a channel for moving ore from the stope to the cars, but they also furnish valuable space for storage. A temporary track is laid on the sill-floor of the stope, and, for the first few floors, it serves for the removal of the ore as it is mined, but after a short while, owing to the weight of the stope and the accompanying squeezing and crushing of the timbers, this temporary track is abandoned. All haulage henceforth is done through the main foot-wall drift, which is effectively protected against all stope-settling by the foot-wall rock in which it is run.

4. In this system of stoping, the cutting out of the sill-floor along the hanging wall is always done first. As the

sets go into place against the hanging wall and as they are extended upward, the advance is made toward the foot-wall. When that is reached, the hanging-wall sets may be five or six high. This is the critical stage of the operation, because no filling has been introduced as yet and no raises have been made for handling the waste. Once this stage is passed, all is safe.

Mr. Easton tells me this system of mining was developed and put into successful practice by William McDougall, the mine superintendent. No ground is now excavated by the old style of flat-backed stopes; any narrow veins, not requiring square sets, are mined with stulls and filling, but such veins have only been exploited below the No. 10 level.

In the Sullivan workings, which are in the Revett formation, the quartzite is dense, hard, and tough, but in the main workings, owing to the general fissuring both prior and subsequent to ore deposition, the ground is relatively soft. Near the main fault-fissure, it is extremely 'heavy'. No amount of timbering can hold the ground for long. Immediate and complete filling of the stopes is necessary to sustain the 'back'. The sets of timber merely provide temporary protection for the miners and a position from which work can proceed; the timbers cannot be expected to keep the excavations open permanently, and in most of the workings no unfilled spaces wider than two sets are to be seen. Usually the working-face has a space only one set wide. The chief care and the biggest expense are incurred in obtaining and distributing the waste for filling; the bosses underground give this phase of the operation their close attention. For this reason, and also to maintain a satisfactory grade of mill-feed from relatively low-grade stopes, it becomes necessary to sort the ore into wheelbarrows while the larger fragments of waste are thrown into the 'waste-corral' formed by 'lacing' slabs from the saw-mill around the square sets that are to be filled. This keeps the waste where it belongs—in the stope, not the mill-bin. No waste whatever comes out of the mine; any that may be needed for filling, over and above that coming from sorting and exploratory workings, is furnished through special raises in one of the convenient upper levels. These raises are run to tap fault-fissures known to be in soft ground; they are not used for exploration. The raise caves, and the waste from it is drawn over the chute-lip at the bottom into cars, thereby reducing the handling of such material as much as possible. Careful plans are made for the transfer of it into the stopes requiring to be filled. These raises are underground quarries; they have furnished many hundred thousand tons of filling at a cost of about 5c. per ton delivered into the stopes, and no injurious consequences have resulted or even been threatened by the caving. It is practicable to 'pull on' some of them for years; the broken rock continues to come, with the aid, once in a while, of a stick of dynamite to blast a block, or 'choke', and encourage a fresh movement. Formerly it was customary to run waste-raises into the hanging wall of the stopes themselves, but the hanging, when penetrated, was often found to be hard rock; indeed, if it was

†These drawings were prepared for me by Harold M. Childs (U. C. '02), the company's chief engineer.

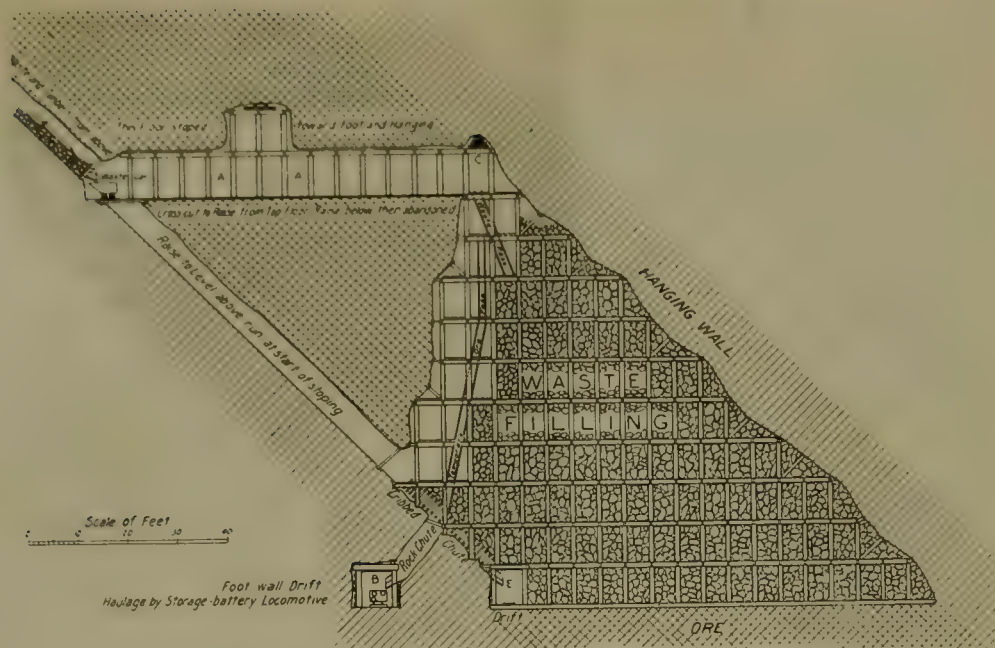


FIG. 2. CROSS-SECTION, SHOWING PRESENT SYSTEM OF MINING

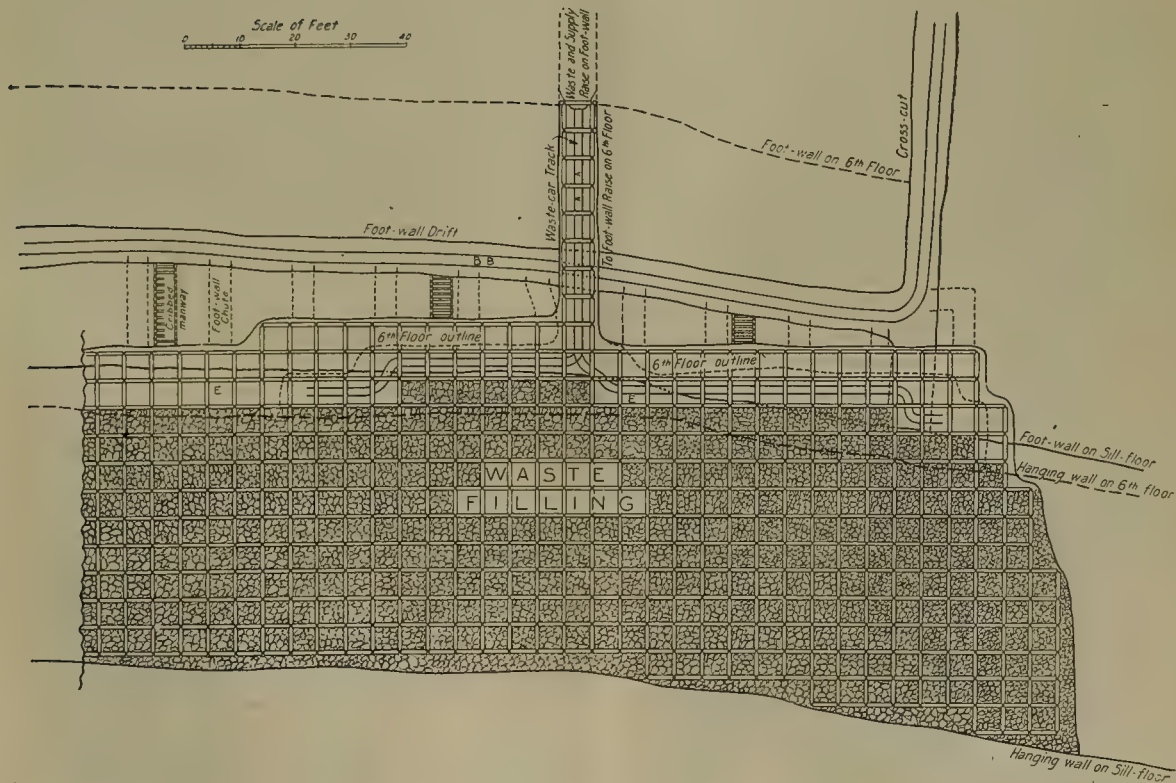


FIG. 3. PLAN, SHOWING PRESENT SYSTEM OF MINING

not hard, the raise could not be maintained. The cost of drilling and blasting in such ground was excessive and the work sometimes seriously weakened the back of the stope itself. Such raises were likely also to tap fresh sources of water seepage, which became a nuisance and a menace. This method has now been entirely discarded in favor of the caving system already described. At one time serious thought was given to a scheme for using the empty returning ore-trains from the mill for the purpose of hauling the mill-tailing, to be dumped into the stopes below the adit. This method, besides its cost, would have the disadvantage of rendering the tailing unavailable for re-treatment at a later date. It could not compare in cheapness and efficacy with the present system.

Fig. 4 illustrates the timbering of a raise and chutes in the Tyler workings. Two chutes with a skip-way and a man-way are shown. This method has been abandoned. The objection to it is that the weight of material in the chute bursts the lagging and presses against the skip-way and man-way. Chutes and skip-ways should be kept entirely separate. I give Fig. 4 as a warning.

Fig. 5 shows the timbering of a station at a two-compartment inclined shaft in plan and section. This is the method of timbering still in use throughout the Coeur d'Alene.

Fig. 6 is the section of a stope supported by stulls, as still used. It is a standard method and shows a cribbed chute with a lip, together with a collar or platform for receiving broken ore and waste-filling, to be banked against the hanging wall.

Fig. 7 is a timbered structure that was used in driving the Kellogg adit, in order to expedite the tramming. It was protected by steel plates along its inclined surface and was pushed against the pile of broken rock in the face. A small scraper was pulled up the incline by a compressed-air hoist and dumped into the cars. The entire structure was moved on wheels, as shown.

Returning to the present system of mining, I venture to add further details. The chutes in the stopes are built in log-house style, with sticks of cribbing $3\frac{1}{2}$ ft. long, made from 6-inch round timbers of Douglas fir. These sticks, for purposes of economy, are generally split by a saw, and, to protect them from wear, are lined on the bottom with 3-inch fir or tamarack plank of random widths. Two-thirds up the sides they are spiked in place against the flat face of the split cribbing. The man-ways are built of full round cribbing, 6 in. diam., without any lining. This round cribbing affords footing for the passage of men and attachment for air-pipes. Where the inclination is more than 50° , ladders are spiked into place. The construction of chutes and man-ways is the same in square-set stopes as in stull-stop. Chutes are spaced in accordance with the width or quantity of ore; the minimum distance between chutes being 25 ft., whereas the man-ways are placed 100 ft. apart. Where ore is plentiful the chutes are placed 15 ft. apart and the man-ways at intervals of 50 ft. only.

The development of a mine is based upon the physical structure of the orebodies and of the country-rock en-

closing them. The main fissure traversing the Bunker Hill property used to be known as the Wardner foot-wall, but now it is recognized as the Cate fault. For many years the fissure was considered the lower limit of the lode, because all the known orebodies were in the quartzite of the hanging wall. Therefore exploratory development work was planned on this supposition. When proved wrong, the method of exploration had to be changed. Between 1900 and 1902, a great deal of driving and cross-cutting was done on the level of the Kellogg adit without finding any important orebody. In the summer of 1903 new orebodies were found, and since then there has been no looking backward.

Here I may state that in the course of the development work done during the last 12 years, it has become evident that in depth the Bunker Hill ore-shoot is drawing away from the Cate fault. The stopes on the No. 10 and No. 11 levels were closest to it. The fault formed the hanging wall of these stopes, and this was partly true of the No. 12 level, where much ore was stoped from between the hanging wall and the fault. On the lower levels only the east end of the Miller stope on No. 13 level touched the fault, for a distance of 150 ft. out of a total stope-length of 850 ft. The Day stope, on No. 13 level, is not closer at any point to the Cate fault than 300 ft.; the Plemmons stope, above No. 14 level, comes no nearer than 200 ft.; and the Newman stope, on No. 15 level, no nearer than 400 ft. This structural relationship between the main ore-shoot and the principal fault has influenced, in large measure, the method of mining. In places the fine-grained galena near the foot-wall looks like graphite. Some of the miners had the old-fashioned idea that, being so fine grained, it must be rich in silver; so they took some of it away with them in their dinner-buckets, until they were disillusioned. In an accompanying illustration, the reader will note a beautiful example of normal faulting as seen in the Mike stope on the Frances vein in January of this year. The photograph fails to make clear the one foot of solid galena directly underneath the white vein of quartz, but the line of the fault-selvage and the 'drag' are fairly well shown.

At the beginning of 1903 a new plan of exploration was started, namely, that of tracing the known ore on the Reed tunnel-level by means of short cross-cuts on successive lower levels, so that, step by step, its extension on the dip was traced. Soon it was ascertained that the main orebodies had departed from the line of projection previously assumed and also from their supposed relationship to the so-called Wardner foot-wall. This prime fact being once established; the ore was readily uncovered on the No. 7 and No. 8 levels, which are 400 ft. and 200 ft. respectively above the Kellogg adit. The extremely productive Cary and July stopes were opened up in 1904; and on St. Patrick's day in the same year the great March orebody was cut on the Kellogg level by a cross-cut 200 ft. from the line of the adit itself, but in a more easterly position than had been surmised. Within five years the production of the mine was more than doubled in tonnage and the grade was 75% higher than previously. During

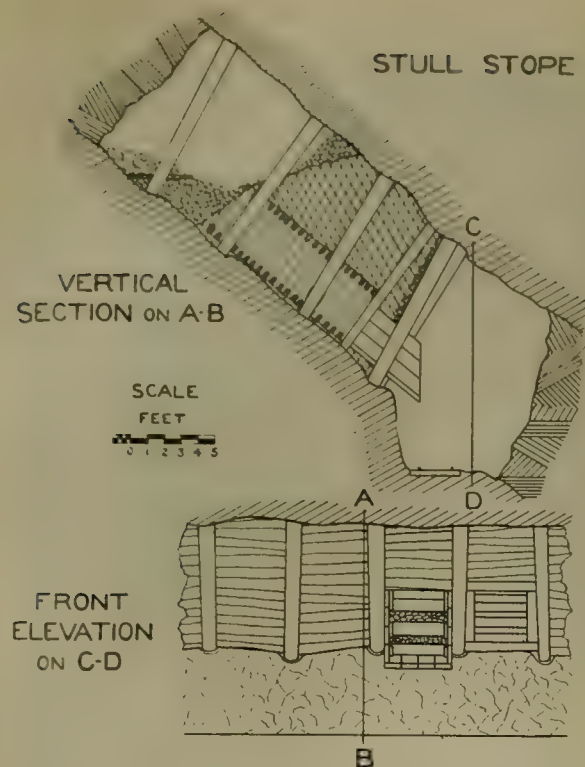


FIG. 6

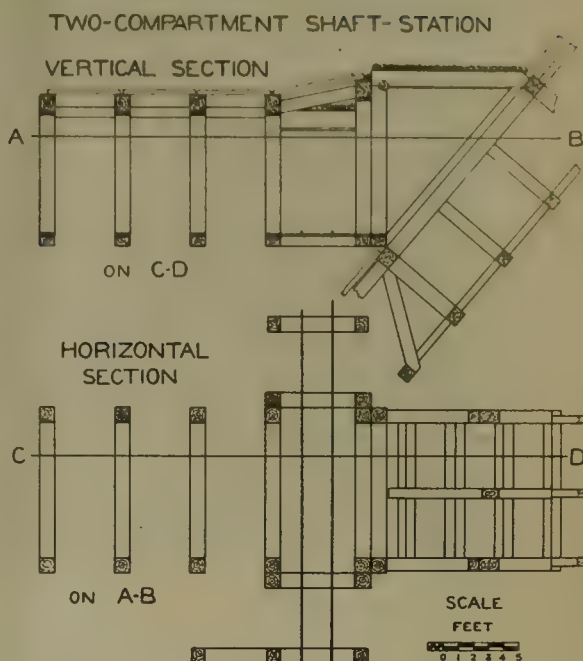


FIG. 5

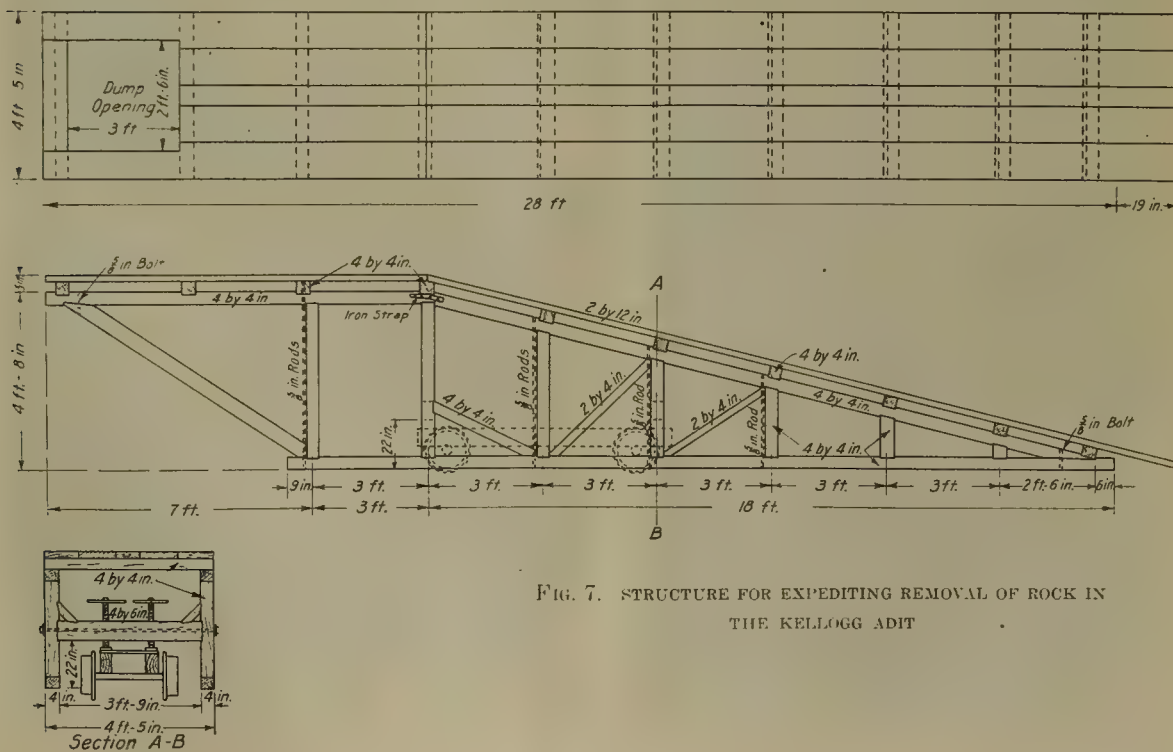


FIG. 7. STRUCTURE FOR EXPEDITING REMOVAL OF ROCK IN THE KELLOGG ADIT.

1905 the sinking of the main shaft was begun and in 1906 the ore was cut on the 10th and 11th levels, which are 200 ft. and 400 ft. respectively below the adit. On the 11th level the Cameron orebody, which extended directly under the Cate fault, was over 800 ft. long and was stoped on the sill-floor for a width of 180 ft. This stope is still productive and the eastern end of the ore has not yet been determined; it has made a yield already of 905,000 tons, which is at the rate of 8013 tons per vertical foot. This main Bunker Hill ore-shoot has been continuous from grass-roots. In addition, numerous other large and high-grade stopes are now being worked, so that 47.6% of the mine output has come from ore-shoots* other than the one on which the discovery was made in 1885. Outside

grand total of \$22,000,000, over \$20,000,000 has been paid since 1904.

Experience in the mining of lead deposits elsewhere shows that in depth they usually become contaminated with an increasing proportion of zinc-blende and pyrite together with other undesirable minerals, the presence of which connotes an impoverishment in lead and silver. In this mine, however, no such unfavorable change is to be noted. The deepest level, which is No. 15 and is 1200 ft. below the Kellogg adit, or 3000 ft. vertically beneath the surface, shows ore of a grade and composition superior to any heretofore mined on the upper levels. To the remarkable uniformity in the character of the ore, the mine owes its great and profitable production. This is attributed by geologists to the fact that the workings of the mine have not passed through the altered sedimentary beds that

enclose the lode-channel from grass-roots downward, because the lode is inclined at a low angle to these beds, so that whereas physically the mine has attained great depth it is still high in the stratification. The wonderful network of fractures continues, and with it the conditions that were favorable to chemical interchanges between mineralizing solutions and the shattered quartzite. When the ground becomes 'tight', as a miner says, and the fractures become fewer in number, then it may be anticipated that the lode-channel will exhibit impoverishment. Of that there is no sign as yet.

In the past, as in most large mines, fires underground have been a cause of much annoyance and expense, but, fortunately, only one life has been lost from this cause in the whole history of the Bunker Hill. These fires have originated

in the stope-timbers, for the ore does not contain enough sulphur to ignite or burn. The most serious fire was in February 1906. A choked chute was blasted by a timber-man; either the charge failed to explode and merely burned, or the splintered wood was set aflame by the explosive; in some way the fire passed to the timbering, extended up the chute, and was soon rampant in the dry timbers of the Flint stope above the No. 7 level. At that time, 13 years ago, little or no fire-fighting equipment was available and the oxygen-helmet was unknown. However, every available appliance was put to good use. By plentiful employment of brattice-cloths and ventilating-pipes, an approach was made to the fire and the first attempt was started to extinguish it directly. Some good work was accomplished, but it was soon ascertained that the fire had passed beyond reach into sets within the body of the stope; whereupon it was attacked from the No. 6 level, 200 ft. overhead. So-called water-drifts were run by miners working on 6-hour shifts. These drifts were on a dead level or slightly down-hill and were made as small as sufficed for a working space, that is, 4 by 5 ft.

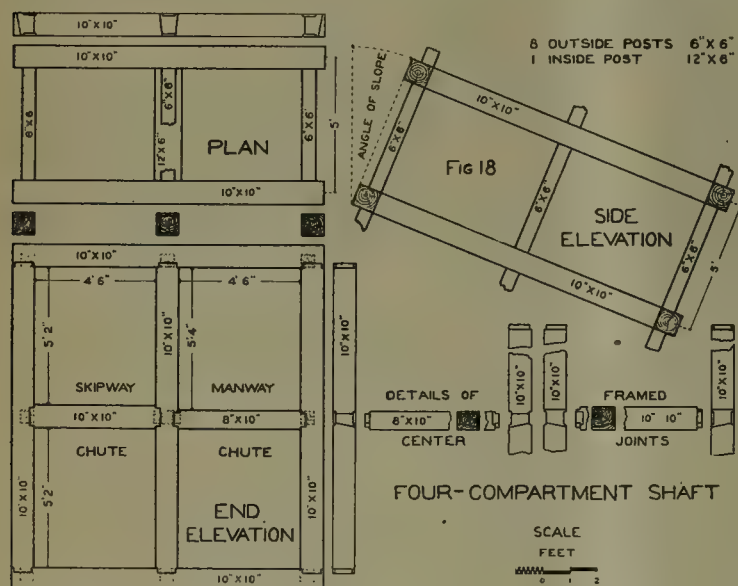
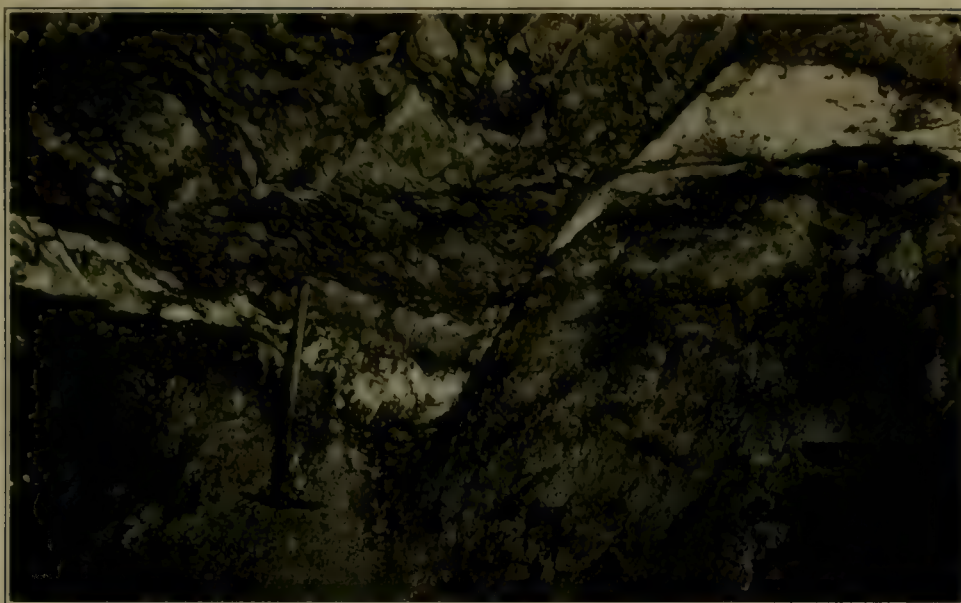


FIG. 4

these larger orebodies, there are numerous stopes on the quartzose veins that extend from the main lode, which, as the reader will recall, is characterized by a gangue of siderite. These quartzose orebodies have been stoped individually for distances of over 1200 ft., for widths ranging from one foot to 15 ft. A few of the wider veins are mined by square sets and filling, but most of them are mined by means of stulls and cribbed chutes, as described in the earlier part of this article. These quartzose veins appear to be older than the Bunker Hill orebody, as indicated by their relation to the faults. It is remarkable, having regard to the old notion of the Wardner foot-wall, that these veins occur exclusively below that fissure, which on the upper levels seemed to be the lower limit of the lode.

How these discoveries and the better method of mining contributed to the prosperity of the Bunker Hill enterprise is shown by the record of dividends, for out of the

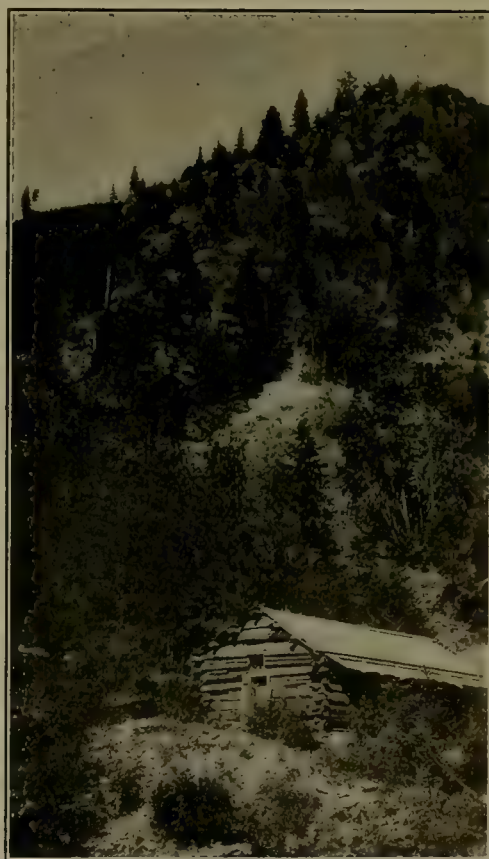
*Up to January 1, 1919, the mine had produced 8,275,913 tons of ore; 52.4% of this had come from the main, or Bunker Hill, ore-shoot.



NORMAL FAULT ON THE FRANCES VEIN



MILO GULCH AND THE SULLIVAN WORKINGS



THE OLD BLUEBIRD CABIN AND THE PHIL SHERIDAN OUTCROP

The first of these drifts was run in the form of a crescent so as to encircle the entire area on fire. As soon as the surveys showed that this had been completed, this encircling drift was pumped full of water. The stream percolating from it formed an effective curtain of water, which restricted the fire within a small area. Then other water-drifts were run, so as to form a gridiron of openings above the burning area, and as fast as each drift was completed it was pumped full and kept full of water. That these methods were effective was shown by the scalding water that emerged on the No. 7 level, below the fire. Efforts also were made to reach it from below by ascending man-ways and carrying pipes with water under pressure from pumps operated by compressed air. Red-hot rock was reached, but only limited results ensued. Meanwhile the running of the water-drifts was being pushed diligently and the descending shower of water increased until by the middle of July—five months after the start of the fire—the entire area was under shower and the fire at length was extinguished. All this was done without loss of life or injury to anyone, although at times the workings adjacent to the fire were full of carbonic acid gas, which had the effect of rendering several men temporarily insensible.

In October 1912 another fire broke out in a station at the head of the main shaft, but, thanks to a superior fire equipment, including oxygen-helmets and trained men, this was extinguished in a few days. The station was not re-timbered; instead, it was lined with concrete distributed by means of a pneumatic gun. Much of this concrete was reinforced with steel bars. Later, it was decided that such reinforcement was unnecessary, the massive and well-arched concrete lining being sufficient to support the ground. Over 1000 cubic yards of concrete was used; the bins and approaches to the station, as well as the station itself, being lined with concrete from one to five feet thick. At this time also the station at the collar of No. 2 shaft was lined with concrete, and later certain parts of the adit, where soft and heavy ground required frequent re-timbering, were covered with concrete as a permanent protection.

With the exception of the thick and highly silicified beds of the Revett formation, which are slow drilling and tough breaking, the ground, both in the lode itself and in the outer country, is easily drilled and breaks well. A round of holes in a drift will break $4\frac{1}{2}$ ft. and is readily drilled in less than the 8-hour shift.

The ground breaks as well in cross-cuts as in drifts. To indicate the character of the rock, it may be noted that, including all development and shaft-sinking, only slightly more than half a pound of 35% gelatine, that is, the lowest desirable explosive procurable, is spent per ton of ore, as compared with more than two pounds per ton at Treadwell, for example, or $1\frac{1}{4}$ pounds on the Rand. For years the standard practice has been to perform all the mining on the day-shift, leaving a small crew at night to clear the broken ore and rock from the drifts and cross-cuts, to do the tramming, and to attend to the minor jobs incidental thereto. This practice is made possible by the

large amount of ore opened up, the exceptional storage afforded by numerous capacious chutes and spreading of operations over an area that includes 19 different stopes, some of which singly can provide over 300 tons of ore per shift. The advantages of confining the drilling and blasting to the day-shift are obvious; day-work is pleasing to the men; moreover, it facilitates competent supervision, for each workman and each boss has his own sphere of operations for which he is directly responsible, and he has a place where he is able to plan and perform his work without clashing with the ideas or doings of others. This free scope appeals to the intelligent man. Sunday work is avoided as much as possible. Those who desire to work on the seventh day are given the opportunity to do so, but except during the War, when there was a shortage of labor, it has been the policy of the manager to discountenance Sunday work. There was opposition to this custom when it was first established, so it was introduced by degrees, first by 'laying off' on one Sunday in each month, then two Sundays, until the men learned to appreciate that it was to their benefit. They came to like the custom so much that if ordered to work on a Sunday they would demur or find an excuse for 'laying off'. It is undoubtedly a fact that this recognition of a day of rest has resulted in better conditions from the standpoint both of the employer and of the employee, enabling the staff and the workmen alike to find time for the necessary change and recreation. The smaller number of accidents, both the slight ones and the fatal, while largely due to the safety-first propaganda and to prohibition, is to be credited also in part to day-work, with its attendant closer supervision, intimate knowledge of the workmen concerning any change of conditions in their place of work, and also to the opportunity for the healthful variation afforded by the spell of rest on Sundays.

Nevertheless the mine is productive even on Sundays, because the train-crews remain on duty and haul ore from storage in the numerous chutes underground, so that the operation of the concentrators and smelter is continuous. The manager always keeps in mind the fact that the mine is the mainspring of all the resultant activities, and the work of the entire enterprise is based upon that fact.

All materials are carried through the raises connecting with the backs of stopes. Dulled steel, however, and tools in general are carried down the man-ways by 'nippers', or young boys, to the tool-car on the level below. Water for drinking is piped to all the levels from the surface; from stations on the levels it is carried to the stopes by hand in 10-gal. galvanized-iron cans furnished with a hose. Small canvas water-bags are supplied to the miners at cost and many workmen use them to take their individual supply of water to their place of work. These water-bags have proved satisfactory. For sanitation, flush-closets are provided on most of the levels, at or near the shaft; they discharge into the drainage system of the mine and eventually into the sumps below the pumps. The dilution is said to be so great as to prevent any unpleasantness, there being a flow of water in the mine ample for flushing the latrines and preserving sanitary

conditions. The water from the mine is used in the mills; it amounts to 600 gallons per minute.

VENTILATION. The natural circulation of air in the mine is excellent throughout the workings above the adit, thanks to the numerous connecting workings, and for several levels below the adit as well; it is regulated by the difference between the temperature underground and that at surface. When the atmosphere outdoors is warmer than 56° F., the air in the mine flows outward, and when the thermometer registers below 56° F. on the surface the air flows inward through the adit. In a few stopes where men are working and in which square sets are used the temperature rises, after the third cut has been made, from 60° to as much as 80°. The air is humid and stimulates perspiration. The workings adjacent to the Cate fissure are particularly warm, owing probably to chemical action in the crushed rock. After a few years the filling in the stopes shows oxidation by its change of color and the cementing of the broken material. Heat is due to this cause and to the decay of timbers. In the stull stopes the air is cooler than in the square-set stopes. On No. 10 level (200 ft. below the adit) the humidity reaches the dew-point. On the same level the natural ventilation has been supplemented by a blower of the Sirocco type, which delivers 60,000 cubic feet of air per minute as a down-cast. This fan is actuated by a 30-hp. motor. In addition, an exhaust-fan of the same type, and of 45,000 cu. ft. capacity, has been erected recently on the Kellogg level, close to the No. 2 shaft. This will serve to establish an up-cast, drawing the air of the warm stopes.

The timber used in the mine comes from the north fork of the Coeur d'Alene river and from the lake of the same name; it is brought by train and delivered at a cost of 6½ to 7 cents per linear foot of 10-in. round poles.

The chief question regarding a mine is its health as it grows old, for upon that depends its economic life. On the 1500-ft. level, which is 1200 ft. below the adit and 3000 ft. beneath the nearest surface, the lode is reached by a cross-cut 800 ft. long, from which a drift extends for 400 ft. each way in the Bunker Hill main ore-shoot. The level, for this 800 ft., is in ore for its full width. The cross-cut has been extended to the No. 2 shaft, a distance of 600 ft., and cuts the Frances fissure, in which 6 ft. of ore shows, and also the Barr fissure, which likewise shows a full stoping-width of good-looking ore. All the veins look normal and yield ore of an average grade or better. In short, the bottom of the mine is healthy; the showing of ore is as good as at any level above; and the life of the enterprise has as yet no visible end, although, of course, the Bunker Hill lode, like all others, must become impoverished eventually as the mine is deepened. The workings have gone through the Revett quartzite and are now in the Burke formation. These are the terrains to which profitable mining in the Coeur d'Alene is largely confined. The Burke quartzite has a thickness of 1500 ft., this formation has been reached recently by the deepest workings; therefore stratigraphically the conditions continue favorable.

(To be continued)

PERHAPS the most striking feature of Burma's export trade during the past five years has been the rapid increase in the exportation of minerals. The principal metals exported are wolfram, lead, silver, and tin. Wolfram and tin are found in the mountains separating the Tenasserim coast from Siam and in the northward extension of these mountains into the Southern Shan States. These metals are exported chiefly from Rangoon and from Tavoy and Mergui. Before the War most of the wolfram went to Germany; now it all goes to the United Kingdom. The tin ore is generally shipped to the Singapore market, to India, or to the United Kingdom. The wolfram and tin of Burma are produced by many companies, large and small, and mining methods are generally crude. All the lead and silver exported from Burma come from the Bawdwin mine. This mine is situated at Bawdwin in the Northern Shan States, and is operated by the Burma Mines, Ltd. The ore is refined at the smelter at Namtu near the mine, and the lead and silver are sent by rail to Rangoon. The lead is sent principally to Ceylon and India, where it is said to be used in the manufacture of tea chests; but a good proportion of this metal was sent to England, and, especially during 1917, to Vladivostok. The silver is exported as 'treasure', principally to India, where it is minted into rupees.

THE COMBINED OUTPUT of the coal mines in the Loire basin in 1918 is estimated at 4,918,116 metric tons, an increase of 380,276 tons as compared with the preceding year. The work of recuperation in connection with coke-ovens gave the mining companies a market for by-products hitherto imported. A great scarcity of fuel marked the beginning of the year 1918. Many factories had to close down for that reason. The shipment of considerable quantities of coal to Italy and the congested state of the railroad traffic also contributed to the crisis. The events at the seat of war called for an increased production, and the output of certain mines increased 15%. There was great rivalry among the mining companies, and secondary concessions hitherto abandoned were put into operation once more.

THE drinking water used by miners underground is of as much importance as that in use on the surface. The water used for drinking purposes underground should be free from filth or contamination. Many diseases are spread in this manner, among which are common colds, influenza, pneumonia, and syphilis. Where drinking water is piped underground a simple sanitary device may be arranged by means of a pipe, with a union on the end too big to be placed in the mouth. It is better so to place the union on the end of the pipe that the water will not come in an upright stream, but pour out on the side.

THE U. S. Geological Survey now has available for distribution its annual statement of the production, exports, and imports of sulphur and pyrite in the United States in 1918. The sulphur produced in the United States in that year was 1,353,525 tons.

The Human Element in Mine Operation

By EDWIN HIGGINS

INTRODUCTION. To operate at maximum efficiency a mine must have not only suitable equipment and proper methods; it must have laborers who return an honest day's work for the wages paid to them. Bearing in mind that in metal mining generally from 60 to 70% of the total cost of production is chargeable to labor, it may be seen readily how seriously labor performances may be reflected on the cost sheet.

THE HUMANE METHOD. "How can I get better co-operation from my men?" is a question often asked by mine officials. In the last two or three years, during which the efficiency of labor has decreased to such a great extent, this question has been frequently asked. The answer is to be found in the fact that the degree of loyalty in a workman is a direct measure of his value to his employer. The higher the degree of loyalty, the more valuable is the man. Therefore, in order to secure the best results, it is necessary that workmen be accorded such treatment as will win and secure their loyalty. To accomplish this there is no better method known than the policy of the square deal and humane treatment. The truth of this statement has been demonstrated by thousands of employers.

A striking example of employers of this class is James H. Foster, of Cleveland, Ohio, a man who converted a small shop into a steel-fabricating plant with a yearly business of \$25,000,000. The following paragraphs from an article recently written by Mr. Foster are of interest:

"Men are square. I believe that to the very underpinning of my soul. I do not mean some men, or even the average man. I mean the overwhelming majority; all but the few scattering votes that do not affect the final returns. I suppose that the men out in my plants are no different from men in Duluth or Birmingham, and that I have a right to judge by them. As I have worked with these men and played with them they have continually brought home to me the fact that the big thing a human being wants is a decent right to self-expression and self-respect. And he resents any attempt to deny him this right.

"The employer who takes men thoroughly into his confidence is making an investment with amazing possibilities. When we adopted the eight-hour day there was one department in which it seemed doubtful that we could get enough production to avoid a clear loss. I went over the situation thoroughly with the men in that department and explained the breakers we saw ahead. I have never seen a body of men take hold of a problem more intelligently and earnestly. Through their own efforts the production in that department became greater in the eight-hour day than it had been under the old ten-hour schedule.

"Any plan for increasing the contentment of workers must be built from the bottom. Our present personnel committees are merely an outgrowth of the old weekly conferences held in each department, when the workmen used to gather around the superintendent or the general manager and unburden themselves of all the knocks and boosts they had been storing up. Those old conferences give me mighty pleasant memories. I can still see the men sitting around on automobile frames, plumb full of intelligent interest, and talking out what they thought about things. If a demand was not reasonable the management seldom had to say so. The man's fellow workmen would "shush him down", and then, if necessary, take him into a corner later and argue the matter out. Then we grew so big that weekly meetings in each department were out of the question. So the personnel committee was born. The committee in each plant is made up of one representative for every thirty men, elected twice a year. The company's only stipulation is that he must be an American citizen and in our employ for one year. This committee lays all the problems of the men before the management. Its recommendations are always accepted, unless we are able to point out a clear impediment which the men had failed to take into account.

"I always tell our foremen that their work is divided into two parts: to know their jobs and to know their men, and that the second is the more important of the two. The foreman who gives the men under him a square deal, who leads them instead of driving them, is worth more to the company than a man who could write fourteen textbooks on his trade."

THE ROLE OF THE CHIEF. It is true that many dividend-paying mines are in charge of men who have little or no regard for the human element. It is equally true that many such mines are not operating at maximum efficiency, although they appear to be, because they are paying dividends. Where the ore is of low grade and every device must be used in order to squeeze out a profit, the successful operator will be the man who is surrounded by a crew of loyal workers. To illustrate this point, two extremes may be cited:

On the one hand, picture a manager who is a driver of men, getting results because his employees are afraid of him or afraid of losing their jobs. These employees have no kind thoughts for the boss; they refer to him in slighting terms and possibly make faces at him behind his back. On the other hand, let us consider a manager who, by humane treatment and the square deal, has won the respect and loyalty of his men. To sum up in a few words, his employees would 'go to Hades' for the 'old man'. It is unnecessary to ask which of the above two managers stands the better chance of successfully operating a mine.

Labor may be divided into three classes: (1) The loyal worker; (2) the worker who lacks enthusiasm and is on the fence as regards responsibility to his employer; (3) the discontented worker, the trouble-maker. The problem before the employer is to bring as many of his men as possible into the first class.

The application of the principle of the square deal and humane treatment must of necessity originate with the manager, superintendent, or man in charge, whatever his title may be. For brevity he will be referred to herein as the Chief.

The development of loyalty and a spirit of co-operation within the organization should be one of the most important concerns of the Chief. If he has a natural disposition to treat fairly and humanely with his employees his task is not a complicated one. Lacking a natural bent in this direction it may not be a difficult matter to correct the fault.

Engineers as a class are analytical, and because faults can be found in almost any operation, they are likely to be critical, even hyper-critical. In searching for inefficiency or the cause of poor operating results, the Chief should first reverse the usual order of things and analyze himself. For instance he might ask himself, "How do I stand with the men? Are there any of them who would make a trip to Hades for me? How many of them would put a little extra effort in their work over and above what is called for by their day's pay?"

RELATIONS OF OFFICIALS AND BOSSES. It is not only important that officers and bosses be fitted for the positions they hold; they should be men who can and do work together as a harmonious unit. The spirit of co-operation should be strong, with every man doing his share to get results. It is unnecessary to point out the disastrous results which inevitably come when one or more men in an organization begin pulling in the wrong direction. Emphasis should be laid, however, on the necessity for securing co-operation.

The exact method of bringing about harmony and co-operation depends largely on the personality of the Chief. He may find it necessary, in order to remedy troublesome conditions, to shift his men about. He may have in his organization one or more men who are most efficient workers, but who are inclined to cause trouble. Ordinarily, it is worth considerable effort to change the viewpoint of such men, but if they cannot be converted, the organization is better off without them.

One of the commonest causes of discord and discontent is the disregard, on the part of the Chief, of that basic principle: responsibility and authority must lie together. No mistake can be made if this principle is followed throughout the organization. On the other hand, trouble is inevitable when it is ignored.

There is one simple remedy that may be regarded as almost a sure preventive, as well as a cure, for discord in the organization. Reference is made to regular meetings of officials and bosses. At such meetings operating troubles may be discussed and suggestions for betterment made; an opportunity is presented for the men to get

closer together and familiarize themselves with each others difficulties and viewpoints. These meetings tend to develop those who have a natural desire to remain in the background and keep their ideas to themselves; they induce a greater interest in the work, and take away the idea of some that they are only cogs in a wheel. No one man knows everything, and six or a dozen heads, even though some of them developed only in the stern school of experience, are better than one head, no matter how refined may be the brain matter contained within it.

Meetings of this kind are being held by many mining and industrial companies throughout the country. Some of them are weekly, some semi-monthly, and some monthly. Many companies precede some or all of their meetings by dinners, followed by something to smoke and now and then some kind of entertainment.

TREATMENT OF THE WORKING CREW. The average man will without doubt respond to humane treatment and the square deal. In putting the policy into effect, it is important that as little noise as possible be made about things done for the men. Some companies are today nullifying the results of their work by shouting from the housetops regarding their philanthropy toward the working man. Procedure of this kind breeds resentment and can result in no good.

The aim of the management should be to remove reasonable cause for dissatisfaction, make such improvements as will tend to attract a high class of labor, and to so regulate relations with the men as to win their loyalty and respect. In working toward these ends it is essential that the Chief set the proper example by his attitude; and he must see to it that his officials and bosses reflect this attitude.

In looking for causes of dissatisfaction, or opportunities for betterment, attention should be directed to the following: Relations with the men, housing, feeding, sanitation, recreation and amusements, education, safety, social and religious affairs. The relative importance of the above factors depends largely on the class of labor, size of the operation, and location of the camp (isolated or otherwise). At small mines or smelters, it might be desirable and practicable to do only a part of the things indicated; at larger mines or smelters, there may be many other things that should be given consideration. Efforts of this nature are generally referred to as welfare work. This term appears to be rather ill chosen, for it is too suggestive of charity, a thing that working men do not want.

Humane treatment of men need not be accompanied by any lack of firmness on the part of the Chief or any slackening in the discipline of the organization. There need be no change in customary rules and regulations. Care should be always taken to see that men are fairly treated as regards payment for contracts and labor. Trouble-makers should be summarily discharged.

Neither does the policy advocated herein imply undue familiarity with the men, or a too apparent concern regarding their welfare. On the other hand, the Chief should not adopt with his men an air of aloofness; he should at all times be ready to exchange a civil word with

them. Loyalty can be secured by acts of kindness. By keeping in touch with home conditions and personal affairs of employees and lending a helping hand where it is needed, many a man can be won as a loyal friend. Acts of this nature, however, must be done without ostentation and should not be made to appear as charity.

An associate of Mr. Foster recently wrote: "Whenever we have a man killed, J. H. is badly broken up, and he isn't himself for a week. He will call me into his office and ask me all about the man's household; if the widow has plenty of money; if we have arranged with some department store to provide funeral clothing for the family; if the undertaker is making appropriate arrangements; if cars are provided for the funeral procession; if we are speeding up the operation of the State Workmen's Compensation law; if there is anything else in the world he can do. And then the next day he may call me in again to ask if I am sure things are all right."

Poor living quarters and beds infected with insects are frequently the cause of much dissatisfaction. The proper housing of men will do much toward attracting a permanent crew and keeping them contented.

Good food means good spirits, good health, and a sound body. Where the company runs a boarding-house, a study of dietetics is of importance. A table may be lavishly supplied with a menu so improperly balanced as to constitute a menace to the health of the men. This effects their ability to work, breeds dissatisfaction, and causes discontent.

Proper sanitation in and about the mine and camp has an important bearing on the welfare of the community. It plays an important part in keeping men in good health and in preventing epidemics. Cleanliness and tidiness should not only be encouraged about the home, but should be insisted upon in and about the mine. A campaign for better sanitation needs no outline, but should embrace attention to the supply of drinking-water, proper disposal of garbage, efforts to eliminate mosquitos and flies, cleaning of streets, attention to the change-house, removal of rubbish from underground, establishment of latrines, both underground and on surface, and similar details.

"All work and no play makes Jack a dull boy." This is true of miners as well as of other men. After all, men are only grown-up boys. They must have recreation and amusement if they are to lead a natural life. Every employee about a mine usually has a few spare hours outside those devoted to working, sleeping, and eating. If he is kept in the proper frame of mind during these spare hours, his spirit and capacity for work the next day will be the greater. Idle hours, aside from the depressing effect they have on the morale, invite opportunities for fomenting trouble. No argument seems necessary to establish these facts.

If the enterprise is a small one, the problem is difficult, because in this case the item of expense becomes important. The class and nationality of the workmen are important factors. Where the operations are on a large scale, probably the best start is a club-house, which may

embrace some or all of the following: a general assembly room (which may be used also for picture-shows or dances); pool and billiard tables, bowling-alleys, gymnasium, plunge and shower-baths. A counter for the sale of cigars and soft drinks may be added. Many club-houses are able to pay an attendant from the profit of such a counter. Bowling tournaments and boxing matches are popular. If there are a sufficient number of men interested, there is nothing better for promoting community spirit than a baseball team. An organization of this kind, however, must have possible opponents within reasonable reach. In camps where certain foreign nationalities predominate, it is well to provide one or two of their own games.

Where there are a number of children in the camp and no village school-house is within reach, an effort should be made to provide instruction, in both kindergarten and common-school grades. For certain bosses and special men, evening classes in rudimentary mathematics are sometimes of great value. Foreigners who speak only their native tongue may be made more valuable if given instruction in the English language. Educational work may be carried on to a certain extent through proper literature supplied in the club-house, also by the showing of educational moving-picture films. A valuable refinement is a free library.

Safety work is of great value from a humanitarian standpoint. It is a means of preventing much suffering, grief, and hardship, and lessening the number of widows and orphans. As a secondary consideration, experience has demonstrated that safety work promotes efficiency and also lessens costs. A further saving is to be made by accident-prevention work if the company pays its own compensation insurance. Even if the company carries its insurance with some outside concern, the prevention of accidents is of value. Practically every accident that happens in the mine, from a bruised finger to a fatality, costs something in loss of time and demoralization of work. In some parts of the United States, the men all walk out of the mine in case of a fatal accident and do not return until the dead man is buried. When a man is seriously injured, he requires the aid of others. His work stops and the work of those coming to his assistance stops. There is a further loss from the curiosity mongers who want to know what is going on and also from the men or men required to carry the injured man from the mine to the first-aid room.

Of almost equal importance to safety work is the ability to care properly for the injured. This feature can be taken care of by having a certain number of men trained in first-aid methods, and by providing proper hospital accommodations.

In camps that are sufficiently large, the holding of dances and various kinds of entertainments should be encouraged. Any activity of this nature that will tend to develop community spirit should be given support. Where practicable, it is worth while to go to some trouble to afford places of religious worship for members of the community.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NEWS OF KINGMAN AND OTHER DISTRICTS.

HACKBERRY.—The Combination Silver Mines Co. has been formed by Los Angeles people to develop the old Combination mines north of Hackberry. This old property yielded silver in the early days of the Hackberry camp.

JEROME.—Six feet of cross-cutting has been done on the new vein opened 120 ft. north of the old vein of the Shea mine and samples run as high as 417 oz. silver and 14% copper. It is announced that sinking by the Verde Apex Copper Co. of the 280-ft. joint shaft of the Venture Hill and Verde Apex companies to the 500-ft. level, is to be continued without delay. Cross-cutting toward the Black Horse vein will be done at the 500-ft. level. A cyanide plant is being purchased for the Verde Inspiration mine. Sinking is being continued from the 530-ft. level to the 500-ft. level.

KINGMAN.—The main shaft of the Oatman Amalgamated mine west of the Goldroad has reached a depth of 530 ft. Sinking is to be continued to the 600-ft. level at which point exploration laterally will be started. Veinlets carrying appreciable amounts of gold have been encountered in the shaft. The head-frame of the I X L mine has been completed and the shaft is being sunk to the 300-ft. level. Messrs. Hill and Mattson, lessees of the Antler and Copper World properties, have shipped six cars of copper ore since November last. A winze is now being sunk to develop ore below the present level. It is reported that a foot of ore assaying \$130 per ton in gold and silver has been opened in the east drift of the Gold Ore mine. The west drift is in ore valued at \$130 per ton in silver and gold. This ore is being sacked and shipped.

PRESCOTT.—A road is being built into the Tip Top silver mine preparatory to bringing the new machinery recently purchased. Unwatering of the mine is under way. This property was worked for silver in the 'seventies.

COLORADO

NEWS OF THE STATE.—AN OIL-SHALE PLANT.

DENVER.—When one hears of the changes that are in progress in the various metal-mining districts of the State he is almost at a loss to decide whether mining is advancing or declining. For instance, the news that the Portland Gold Mining Co. has abandoned two of its large mills and that these plants have been sold to junk-dealers

tends to give one a pessimistic idea regarding the future of the Cripple Creek district. The 600-ton mill at the mine was abandoned at the time the 1500-ton Independence mill was completed about two years ago. The 800-ton plant at Colorado City has also been idle for some time. Before the abandonment of these mills much of their machinery was placed in the new mill at Victor. But, as an antidote to such news we learn that activities have been or are soon to be renewed in many other parts of the State and that mills that have lain idle for years are being overhauled for renewed service. For instance it is stated that the old Iron City mill at Black Hawk has been secured by a company that proposes to operate the Cyclops and Alaska groups, both former silver producers. Then, just over the ridge at Idaho Springs, we understand that the old Jackson mill is being refurbished for the concentration of ores from such mines as the Bride and Old Town. In this same district, W. E. Leebrick reports the successful promotion of a deal whereby the Mattie mine is to be again operated. If there is anything disheartening in the news regarding the junking of two big mills that formerly extracted gold and silver from Cripple Creek ores, we can find some measure of solace in the occasional discoveries, at greater depths, of substantial ore-shoots. These finds long since disproved the theories advanced by certain geologists, in the early years of the district, that the worth-while ore-shoots would be found only relatively close to the surface.

Mining men of Colorado see serious difficulty ahead if the surveyor-general's office is abolished as proposed in an omnibus bill recently presented in Congress. It is argued that prospectors will not bother with patent-surveys if all the business connected with them must be handled at the expense that will unavoidably be involved in having the office work performed at Washington. A little tempest of protest was inaugurated by the employees of the local surveyor-general's office and it has been boosted by well-meaning mining men until the subject has come up for serious objection by Congressmen from Colorado.

Aspen has credit for the development of at least one new strike—on the Libby Belle ground along the Park tunnel.

GRAND JUNCTION.—The Western Oil Shale Co. that owns valuable oil-shale land near the Colorado-Utah State line, has had erected by the Galloupe Shale Process Co. of Denver, a small but complete education plant, including engines, crusher, conveyor, retort of the Galloupe type,

condensers, bins, and buildings. The accompanying photo shows this plant as it neared completion.

During the past 60 days, this plant has been operated intermittently in test runs under varying conditions of feed, mechanical stirring, and temperature, with the object of securing reliable data relative to the capacity and efficiency of this kind of retort. Continuous runs have not been possible because the crusher is unable to keep up with the retort. The performance of the process has proved so satisfying that the Western Oil Shale Co. has placed a contract for increasing the capacity of the plant to 500 tons per day.

The single retort now in place has a daily capacity of 80 tons and makes an eduction of 95% of the available volatile hydrocarbons in the raw shale. Upon this basis the shale thus far treated has yielded an average of a little more than 50 gallons of crude or total oil per ton. The oil comes from the retort through 17 sets of condensing-pipes, each such set of pipes delivering a product having a specific gravity different from the other products. These fractions are not expected to be fixed nor sharply differentiated but they are sufficiently different to permit the immediate consumption of some of them without further refining. For instance the company's heavy auto-truck is operated upon lighter fractions just as they come from the retort.

In the proposed, enlarged plant, the handling of the shale after it is mined and delivered to the crusher will be mechanical. When the volatiles have been removed from the shale, the residue is dropped from the retort directly into an automatic stoker and all remaining fuel value in the rock is utilized in the fire-box. The thermal units in this spent shale will vary inversely with the thoroughness of the distillation of the shale. There will be found in every sort of oil-shale a point of highest efficiency in this eduction. The volatiles removed toward the close of the treatment possess relatively low market value and their removal from the rock is accomplished only by expending a quantity of heat much in excess of that required to remove the more valuable volatiles. Such residual substances are found most useful on the grates under the retort. The spent shale leaves the bottom of the retort at a cherry-red heat and so easily takes fire when supplied with air in the fire-box. If it were found that the hydrocarbons and the fixed carbon discarded with the shale would not furnish sufficient heat for operating the retort the deficiency would be readily adjusted by burning, in the furnace, some of the permanent gas that comes from the retort. In any event, the item of fuel is well taken care of under the Galloupe system. Some processes propose the burning of oil secured from their operations.

The mechanical engineer for the Western Oil Shale Co. has been tabulating figures for the cost of producing one barrel of crude oil. He gives the information that he believes the proposed 500-ton plant will manufacture such oil at from \$1 to \$1.25 per 42-gallon barrel. He hopes to have the plant operating upon a basis of 100 tons daily about July 1, 1920.

MICHIGAN

GOOD ORE FROM SENECA.—LABOR CONDITIONS.

HOUGHTON.—Mass Consolidated has a million pounds of copper unsold at present. This it is said will not be sold at less than 20c. While the company has no plans for resumption of mining until the metal market improves it is interesting to know that more than 100 of its employees are continuing to occupy the company houses near the mine. Many of these keep their families in the company houses but are working at the Champion or Winona mines. Whenever the company may determine to re-open they will be the first to be re-employed at the Mass mine. The Mass company has sold for \$25,000, to the Sawyer-Goodman company, timber and surface rights on 600 acres, beyond the mineral horizon and five miles north of the mine shafts.

Mohawk made a remarkably good record for 1919, with costs at the mine approximately 9c. per pound of copper, exclusive of depreciation, transportation, taxes, Eastern office, and other expenses. Shafts now opened provide for five years of steady and continuous operation at the present rate. The expectation is reasonable that a copper content of 24 lb. will be maintained. All copper was sold at the first of the year. The company had \$2,000,000 quick assets on hand.

Hancock Consolidated has made its first shipment of 1700 tons of copper ore to the stamp-mill, since work was resumed. It is expected that this will net 14 lb. of copper per ton. Instructions were to send all of the material produced in development to surface, that could be milled at a profit. The shipment went to the Osceola Consolidated mill. None of the openings upon which the Hancock now is operating is in the Pewabic lode proper, but rather in a broken area east of the true Pewabic. Drifting now is under way on No. 12 amygdaloid. This was cut from a cross-cut from the 44th level. The general physical characteristics at this point are the same as those of No. 3 lode, which is the richest of any of those heretofore developed in this part of the mine. The underground working force is being maintained and efficient exploration operations are going forward at 12 different points, all of them indicating evidence of mineralization.

Seneca's third shipment of rock will be made soon. At the present time the physical development of the property is confined to shaft-sinking at No. 1. The lateral openings on the first level were completed to the boundary line some weeks ago. Those to the boundary lines on the second are now complete. The third level drifts have not been started as yet and will not be until the concreting in the shaft is completed. When that is done, which likely will take several weeks, the underground opening in the Kearsarge lode will progress with greater speed than hitherto has been possible. It will include laterals both north and south from the third level and will include the cross-cut to the lode at the fourth level.

The average return on the ore so far sent to the stamp-mill by the Seneca is 29.31 lb. The last shipment contained 35.73 lb. according to the final figures. This is a

remarkable showing, but in accord with the record expected as the mill return was 57 lb. The general run of the Kearsarge lode in the Ahmeek, Mohawk, Osceola, Wolverine, Allouez, and other properties is 25 lb. year in and year out.

At the Gratiot shaft, now being unwatered, the bailing has cleaned out the shaft to the seventh level and within a week it probably will be completely unwatered, for the work is progressing rapidly. It is a good many years since mining has been done at the Gratiot property and it is impossible to state the condition in which the shaft may be found, because it was abandoned with no expectation of resumption. The equipment at the Gratiot is in good condition on the surface now and everything is in readiness to start general underground sinking operations.

The third hole in the present diamond-drill develop-

MONTANA

MINING IN FERGUS COUNTY.

FERGUS COUNTY.—Metal mining was relatively inactive in Fergus county, during 1919. The high cost of mining, a shortage of experienced labor, and the low price of base metals caused several mines to work at less than their usual capacity, and at some operations were discontinued entirely.

Two gold mines at Kendall in the North Moccasin mountains were regularly operated with profit. The North Moccasin mine of the Barnes-King Development Co. produced about \$10,000 per month. Two dividends were paid making a total of \$400,000 to date paid by this company. A new orebody has been discovered and development work has disclosed a considerable tonnage of a good grade of ore. The Kendall mine was operated under lease by A. B. Fox and Lee Hilliard. The ore is



FIRST UNIT OF THE PLANT OF WESTERN OIL SHALE CO., NEAR GRAND JUNCTION

ment of the Calumet conglomerate lode now is being sunk, but at this particular point (this hole is the farthest north-east of all of the holes sunk by the Seneca) the stand-pipe is in a heavy rock. One hole has gone through 40 ft. of boulders at the present time.

There is no change in the labor situation in the Michigan copper region. No men now are leaving from the underground forces at any of the mines and there recently has been some increase to the forces of the Calumet & Hecla. The Mohawk and Copper Range mines have been giving a few men leave of absence. Indicative of the fact that these men appreciate the advantages that come from comfortable homes and good pay it is stated that they are returning to their native land to bring their families back to this country. There seems to be some difficulty in doing this unless they are naturalized citizens. Many of them are making the trip to personally conduct their families to this country. Some few are quitting and going back on account of their dislike for prohibition and its interference with their personal liberty, according to current reports about the mines.

low-grade but is all quarried from a big open-cut, making costs low. There is a large tonnage of ore yet to be mined.

The Spotted Horse and Maginness mines at Maiden in the Judith mountains produced a little ore. The Cumberland was entirely closed. Some tailings were re-treated at Giltedge without much profit. Development work was done at several prospects and it is expected that from now on there will be renewed activity in metal production in the county.

The coal strike caused several new coal mines to be opened and these are now supplying much of the local demand. The mines at Lehigh were closed by the strike but are operating at full capacity now. Their output is taken entirely by the Great Northern Railroad.

The sapphire mines at Yogo in the Little Belt mountains were operated again after being closed during most of the period of the War. The mines are owned by British capitalists, and supply most of the world's demand.

There was great activity in searching for oil during

1919 in central Montana, especially in Musselshell and Fergus counties. The first well was brought in by the Van Duzen company and produced 600 barrels per day. The second well was brought in by the Roundup Oil & Gas Co. the middle of February. Both of these wells are in the Devil's basin about 25 miles from Roundup. The oil is a good grade of black oil. Many rigs are being hauled into the Devil's basin and adjoining fields and 100 test wells will probably be sunk in this vicinity during the coming summer.

BUTTE.—Every surface outcrop of silver and gold-bearing ore, as well as the dumps of the old silver mines, is being worked by numerous lessees, who sort and ship small lots of ore. With the price of manganese around a dollar a unit the manganese mining is rapidly recovering from the blow it received at the end of the War. A few small property holders abutting on Silver Bow creek are causing the mining companies, especially the East Butte and Butte & Superior companies, a good deal of trouble by lawsuits, based on the claim that tailing run into the creek damages their property.

GRANITE COUNTY.—The old silver mines in this district are reviving under the stimulus of the market for silver. The Scratch Awl mine is shipping high-grade ore to the smelter. The ore contains native and ruby silver and gray copper; the mine is owned principally by Butte men.

BEAVERHEAD COUNTY.—Old properties, including those at Bannock, Argento, Quartz Hill, and Glendale, which were rich producers in the silver days, are being reopened. At Argento, M. J. Scott and associates have found a good body of high-grade copper ore. This ore was opened in a drift on the 300-ft. level of the Jack Rabbit mine. It contains chalcocite or copper glance and assays 72% copper and 13 oz. silver per ton.

POWELL COUNTY.—The Emery Silver Mining Co., which owns the Emery mine, situated 10 miles east of Deer Lodge, reports that a contract has been signed and a deal closed whereby C. W. Galvin & Co. of 50 Broad street, New York, will sell 375,000 shares of the treasury stock to finance the development outlined for the Emery. The mill will be remodeled, electrified, and an oil-flotation unit of 300 tons per day will be added. The old waste-dump, which contains 123,000 tons of second-class silver-gold ore, will be milled, as also will be the fillings in the old stopes. The mine will be electrified, un-watered, and the parallel veins as well as cross-veins will be developed. There was only one ore-shoot developed in this mine by the former owners, who worked it until the Emery Silver company acquired the property, which consists of seven full and four fractional claims, as well as interests in adjoining claims. The Emery people came in possession of the mine in 1914 but met with a great many difficulties during the hard time of the War and were finally forced to suspend operations until additional capital could be secured. The test-mill of 50 tons capacity proved that with oil-flotation and electric power the property might be put on a paying basis.

NEVADA

RUSH IS STARTED TO RAND DISTRICT.—ACTIVITY AT EUREKA.

BENTON.—The Benton mining district, partly in Mono county, California, and partly in Nevada, is attracting the attention of Tonopah and Goldfield men, following the purchase of the Joe Main group of claims by the American Prospecting Club of Tonopah. There are a number of old mines in the district from which a large production of silver ore was made in the 'eighties and there is said to be an attractive field for prospectors.

LAFAYETTE.—The Lafayette, in the district of that name south of Candelaria, has been closed because of lack of funds caused by the refusal of the British Columbia bankers interested in the company to make further advances at the present rate of exchange. An effort will be made to re-finance the company in California.

GOLDFIELD.—The Red Hill will soon start drifting south on the 300-ft. level. For a long period all work except in leased territory has been done south of the shaft on the 500-ft. level, but, while promising shoots have been found frequently, an orebody has not been opened. Because of extremely heavy ground the work at 500 ft. has been slow and costly in recent months, but prospecting of this level will continue.

DIVIDE.—Ore 30 ft. wide and assaying \$40 per ton has been found in cross-cuts from a winze sunk a short distance from the 500-ft. level of the Gold Zone, south of the Tonopah Divide and on the strike of the main vein. The find was made practically on the line of the Tonopah Divide and Zone and the ore rakes south-east into the former. The orebody is the first of importance found in the Zone, in which a large amount of work has been done on the 500-ft. level. The ore is a sulphide containing talc.

RAND.—A rush of claim-stakers into the Rand district from Tonopah, has been started by developments in the Gold Pen, Nevada, Rand, and Mimms properties, particularly the first, in which new finds of rich gold ore are reported to have been made. Rand is 20 miles south-west of the old Rawhide district and it was discovered in 1907. The vein in the Gold Pen is from 25 to over 75 ft. wide, with rhyolite and andesite walls. The ore contains gold and silver and is free-milling. A 20-ton amalgamating plant is being built by the Gold Pen to treat ore blocked out which is estimated to be worth well over \$1,000,000, including 400 tons valued at over \$500 per ton. Small shipments of rich ore have been made. The Nevada Rand has produced \$50,000 in ore of medium grade and there is 40,000 tons of fair-grade ore blocked out. The Mimms has shipped \$20,000 in high-grade ore and there is said to be 5000 tons of from \$15 to \$20 material blocked out. The district has produced over \$250,000 in gold and silver.

ARROWHEAD.—Ore 3 ft. wide and assaying \$150 has been found in a drift driven west on the 100-ft. level of the Arrowhead, in which work has been resumed on the former scale.

MINA.—The main shaft of the Simon Silver-Lead mine is in high-grade sulphide ore at a depth of 470 ft. At the 400-ft. level it was supposed to be entering the foot-wall

orebody on the 400-ft. level is over 150 ft.

wide. The engineering direction of the property is in the hands of Burch, Hershey & White, of San Francisco. Mr. Burch has been at the mine to direct development work and Mr. Hershey is said to be conducting the ore-tests. A 50-ton pilot mill, using oil-flotation, will be constructed at once. Blocked-out ore in the main deposit above the 400-ft. level is estimated at 500,000 tons. Drifts have exposed ore beyond the east and west faults. The east faulted orebody is high-grade carbonate for the width of the drift and a product assaying over \$100 per ton will be shipped to smelters.

LUNING.—High-grade silver ore has been shipped from properties east of Luning at intervals for many years,

the new superintendent, is in charge. He was employed formerly as superintendent of properties of the Cerro de Paseo Co. in Peru. H. P. Henderson, consulting engineer, has been at the mine. He says that as soon as the railroad spur is completed 2500 tons of coal will be shipped to the bins at the Locan shaft, which will then be unwatered. The shaft is 1200 ft. deep and water stands at the 985-ft. point. Shaft-equipment and pumps are as good as any in the West, Mr. Henderson said, including two 600-gal. station-pumps and two 600-gal. sinking-pumps. The flow on the 1200-ft. level when the mines closed was about 600 gal. per minute. A cross-cut on the 1200-ft. level had passed through the shale and into the ore-bearing limestone, beyond the Ruby Hill fault. The



THE MEADERVILLE SIDE OF ANACONDA HILL, AT BUTTE

although the district has been known of late years more for its output of copper. The Luning Consolidated Silver Mines Co. has acquired the groups of the Luning Gold Mines Co. and the R. B. Todd Mines Co. and has started work under direction of A. E. Lowe, manager of properties at Tonopah and Divide. A 4000-ft. tram will be laid to convey the ore from the mine to the flat road, and motor-trucks have been ordered to transport the product to Luning, whence it will be shipped by rail to Millers and treated in the cyanide mill of the Tonopah Mining Co. The reports give over 7000 tons of developed ore, assaying \$25, with a considerable quantity recoverable by sorting old dumps. L. F. Browne of San Francisco is president and manager.

EUREKA.—Rails and ties are arriving for the construction of 8000 ft. of track from the main line of the Eureka & Nevada railway to the mines on Ruby hill, held under option by the Ruby Hill Development Co. E. O. Holter of New York is head of this company. L. T. Herchmer,

Locan shaft is to be sunk to 1700 ft. to explore this area. The shaft has two compartments 4 ft. 9 in. by 6 ft. and another 6 by 8 ft. for ladders and pumps. A separate hoist and cages are used for the third compartment. The Eureka-Croesus has received two new compressors, the foundations for which have been prepared. A double-drum hoist is in transit to the property and will be placed at the Catlin shaft. Old workings of the Dunderberg mine are being cleared and the stopes contain much good mill ore. Julius Huebner, superintendent, reports two new discoveries of high-grade ore on the 400-ft. level, one 4-ft. face yielding a product assaying over \$200 per ton. The ore shipped to smelters is silicious and is not penalized for zinc, arsenic, or antimony. The Eureka-Holly has been installing larger hoisting machinery. The Eureka-Climax has an option on the Cloud claim and is driving its main adit to cut the orebody of the old Dead-broke mine.

VIRGINIA CITY.—At the Justice mine operated by

Donovan, Windish, and Robahm, a new shaft is being sunk to cut a large body of ore which was abandoned formerly on account of heavy ground. The operators expect to be taking out ore within the next few weeks. The Justice is one of the old producers of the Comstock Lode, and in the early 'seventies kept 12 mills busy.

Windish and Robahm, operating a lease on the Silver Hill mine, report that they have considerable ore blocked out on the 160-ft. level of the old shaft and are preparing to start the Donovan mill. Negotiations are reported to be under way for the purchase of the Dayton mine from the Hobart Estate Co. The Dayton is known to be a large low-grade property, and one reason for its being idle so long, seems to be the fact that its owners were unwilling to sell or lease the property at a reasonable figure.

Below Silver City the Yuba Construction Co. is completing the gold dredge for the Dayton Placer Recovery Co. Carloads of machinery and equipment are arriving daily, and before many weeks the gravel beds of Gold canyon that have not been worked since the early days of Virginia City will be yielding their gold to more modern methods than sluice-boxes and gold-pans.

UTAH

'UTAH COPPER' REPORT.—STRIKE CONDITIONS AT BINGHAM.

SALT LAKE CITY.—The Utah Copper Co. during the last quarter of 1918 produced 28,013,742 lb. of copper, bringing the total production for the year up to 110,591,608 lb., as compared with 197,978,557 lb. for 1918 and 206,174,442 lb. for 1917, which latter year holds the record for metal output of the company. The total quantity of ore milled during the quarter was 1,372,300 tons, being a decrease of 25,100 tons as compared with the third quarter. The average grade of the ore was 1.2439% and the average extraction was 81.56%, as compared with 1.1633% and 76.20%, respectively, for the third quarter. The higher copper content in the head and improved extraction are responsible for the increased recovery. The average net cost per pound of copper produced was 16.471c., as compared with 14.885c. for the third quarter. The value of the gold and silver in concentrate totaled \$249,787, and the miscellaneous income amounted to \$275,454. These two items combined are equal to 1.974c. per net pound of copper produced. The higher cost for the quarter was due to taking up of increased charges to cover State and county taxes, additional refining charges, and loss on retired property and equipment. The total net profit for the quarter was \$2,699,456, and after payment of a dividend of \$1.50 per share, totaling \$2,436,735, there was a surplus of \$262,721, as compared with a deficit of \$17,223 for the third quarter. The earnings for the fourth quarter are computed on the basis of 21.916c. per lb. for copper. During the period there was removed from the mine 801,433 cu. yd. of capping, making the total quantity of stripping handled during the year 2,062,911 cu. yd., as compared with 4,064,091 in 1918. The Bingham & Garfield Railway handled a daily tonnage of 19,026 during the fourth quarter, as compared with 9949 tons per day for the third quarter, 8734 tons

for the second quarter, and 13,520 for the first quarter of 1919.

BINGHAM.—The Board of Governors of the Bingham Commercial Club held a meeting on February 21, at which resolutions were adopted, vigorously denouncing the I. W. W.s for calling the present strike, and particularly the fact that they have no representatives, headquarters, or any authorized committee to represent the miners in settling their grievances with the operators. It was suggested at the meeting that a committee of disinterested persons be appointed to take up the matter of adjustment with the strikers and operators. On the same day, the strikers held a meeting, at which Albert Wills presided. He advised all miners to get out of camp and to remain away from Bingham and Park City, stating that, in this manner, recognition of the I. W. W. could be brought about. The strike is gradually fizzling out. Most of the mines report that at least 50% of their employees have returned to work. The Utah Apex Co. has again resumed milling operations. At the time the strike was called this property was producing about 600 tons of silver-lead ore per day. All told, it is estimated that about 600 miners have left camp, and no doubt some weeks will be required before the underground mines here will be back to normal capacity. The Utah Copper surface mine was not affected at any time by the strike order, and operations there are going along at normal rate.

OPHIR.—The Ophir Hill Consolidated Mining Co.'s output for 1919 was 33,895 tons of ore, from which was produced 373,435 oz. of silver, 6,595,743 lb. of lead, and 210,242 lb. of copper, with a gross value of \$705,856. The cost of extraction was \$262,737; of reduction, \$226,396, while transportation costs were \$61,089, making total expense of \$550,222. Therefore, the net proceeds for the year were \$155,634.

EUREKA.—Machinery and supplies have been ordered by the South Standard Mining Co. in preparation for active development. This property, consisting of 1200 acres, is situated in the eastern part of the district. A small amount of work has been done at the south end of the property, but the new three-compartment shaft will be sunk at the north end of the company's claims. A double-drum hoist, sufficient for a depth of 1200 to 1500 ft., will be installed.

Three feet of ore, which assays 27% lead and 12 oz. silver, has been encountered in the Eureka Mines property in a raise from the 1000-ft. level. This raise is being driven to intersect an ore-shoot opened some time ago by lessees in the Gemini property, which adjoins the Eureka Mines. It is said that one carload of ore mined by the lessees netted more than \$7000 and that \$27,000 worth of ore has been taken out by them since January 1.

The sinking of shaft No. 2 at the Chief Consolidated mine has reached a depth of 1100 ft. and concreting has been completed to a depth of 1000 ft., according to J. Fred Johnson, mine superintendent.

ALTA.—The Cardiff Mining Co. had an output of 6520 tons of ore during 1919, which yielded 102,043 oz. of sil-

ver, 3111 lb. of lead, 106,982 lb. of copper, and 952,917 lb. of zinc, the gross value of which was \$240,679. Expenses aggregated \$125,806, leaving net proceeds for the year of \$114,872.

Two fissures have already been cut in driving a cross-cut from the long tunnel at the Wasatch Mines property. The first fissure was cut some time ago and contained considerable good ore which could be shipped by sorting. This has been timbered and the cross-cut continued north-erly to the Brain fissure, which it is expected will be reached in about 400 ft. The second fissure penetrated contained some good ore, but was narrow. The work that is being done in this part of the property has greatly reduced the water in the old Columbus Consolidated workings, and there is only about 30 ft. of water left to be drained before the old workings can be again explored. Since the cross-cut was started the water has dropped 20 feet.

BRITISH COLUMBIA

PROPOSED LEGISLATION BEFORE THE PROVINCIAL LEGISLATURE.

AINSWORTH.—A winze is to be sunk from the main cross-cut at the Cork-Province mine to cut the vein 200 ft. below. An electric plant will be installed to facilitate operations. The new work at the mine, which will cost about \$100,000, is being done under the supervision of R. H. Stewart. The 500-ft. cross-cut at the Index mine has passed through the No. 1 vein, and is being continued to cut No. 2. The mine is being operated by a Spokane company organized by E. J. Edwards. The cross-cut into the vein from No. 2 tunnel at the Kirby group has cut through 50 ft. of ore, and has not yet reached the foot-wall. Along the hanging wall was a 6-in. stringer of clean sulphide ore, which assayed from 60 to 2000 oz. in silver per ton and 60 to 70% lead. This stringer was not developed in the No. 1 tunnel, but an 18-in. stringer of equally rich ore was developed on the foot-wall, and the cross-cut is now pointed to cut this ore in the lower workings. About 12 ft. of ore in the centre of the vein is said to assay 22 oz. silver per ton. The high-grade ore is being sacked, and, it is said, pays for the development work. Stringers of similar ore have been cut in the Phillis and in the Gwennie groups, neighboring properties owned by R. D. Hearne and B. L. Eastman, respectively.

NELSON.—The Yankee Girl mine, near Ymir, has been examined by A. W. Newberry, of New York, who spent two weeks on the property, and took a large number of samples. This mine has been one of the largest producers in the district, some 400,000 tons of ore having been taken from the property. It was closed down in the early part of last year, as work was found unprofitable under the high cost of labor and supplies. The principal product of the mine is gold.

VICTORIA.—William Sloan, Minister of Mines, has introduced two bills in the Provincial legislature, now sitting. One, an amendment to the Mineral Survey and Development Act, provides that when a joint-stock com-

pany, other than a private company under the Companies Act, acquires an interest in, or title to, or engages in work on any mining property situated in a mineral-survey district, it must forthwith notify the resident engineer of that district, and file with him full particulars thereof and a copy of the prospectus required by the Companies Act. The penalty for failing to comply with this provision is a fine not exceeding \$25 per day for each day that the default continues. The other bill is an amendment to the Mineral Act, and provides for the withdrawal from location and mining lands containing iron ore, which at the



ARROWHEAD MOUNTAIN, AND THE CAMP AT THE ARROWHEAD CONSOLIDATED SHAFT.

time of the notice in the 'Gazette' of such withdrawal are not included in any mineral claim or mining property held under this or any other act relating to mines and minerals. The amendment further provides for the disposal of iron ore contained on lands withdrawn by the Government under this section on such terms of royalty as may be later determined. The first amendment clearly is being introduced to prevent 'wild catting', and is a necessary precaution at the present time, when there is likely to be a considerable amount of company promoting in the north-west part of the Province. The second amendment has been introduced with a view to developing the iron and steel industry in the Province. In the past large areas have been held for speculation at absurd prices, and in several instances this has possibly prevented the investment of capital in steel enterprises.

STEWART.—A shipment of 250 tons of ore from the Premier mine recently was brought over the winter trail

to Stewart, where it was loaded on the G. T. P. steamer, 'Prince John', on the way to the smelter at Tacoma. R. K. Neill, one of the owners of the property, is reported as saying that a cyanide plant is likely to be built after development has advanced to such a point that a steady supply of ore is assured. Statements from those in a position to know indicate that the Premier is experiencing some difficulty through the activity of agitators among the workmen. Confidence is expressed, however, that this will not seriously interfere with the plans in mind for development and operation.

Preparations are in hand for the commencement of work on the Spider group, which consists of three claims lying north of Long lake in the Salmon River district. This property is under bond to the Algonquian Syndicate of Belgium, represented by W. A. Meloche, a mining engineer who was through the district last summer. Fifty tons of supplies has arrived for the Spider Camp. It is planned to take them over the trail immediately by means of packhorses equipped with snowshoes. Some machinery required for initial development is expected to arrive shortly.

GRAND FORKS.—Active operations are proceeding at the Waterloo mine under the management of G. A. Rendall. A shipment to the Trail smelter consisting of 361 sacks of high-grade silver-lead ore is reported to have been made. Last summer a shipment of 10 tons brought good returns.

MANITOBA

GOLD PAN MINE AT RICE LAKE.

RICE LAKE.—The Gold Pan mine, one of the most prominent enterprises of the Rice Lake district, has so far proved a disappointment and the chances for its making good are not bright. Two reports by engineers who had been engaged to examine the property were recently submitted to the shareholders. The first of these by J. B. Tyrrell was necessarily of a non-conclusive character, as at the time he made his examination the shaft was flooded and he could only examine the surface. He expected to be able to return and complete his work, but was unable to do so and a report was made by R. W. Brigstocke. His conclusion was strongly adverse to any further expenditures on the property. Although the veins contained some rich patches of gold, the quartz outside of these was too low in gold content to be worked at a profit. Moreover the amount even of the low-grade quartz was limited. Notwithstanding the discouraging tenor of the report the shareholders decided on continuing exploration for some months, at the end of which another examination of the property will be made.

ONTARIO

TEMISKAMING REPORT.

COBALT.—During 1919 the Temiskaming mine produced 243,037 oz. of silver with a net value of \$283,623. Costs averaged \$15.61 per ton of ore treated. The surplus for the year amounted to \$70,448, making the total surplus \$993,186. Provision was made for the payment of a

4% dividend in January of this year, and after providing \$29,170 for depreciation the present surplus is \$864,016. In his statement president J. P. Bickell declares the present outlook "does not permit any assurance being given with regard to future dividends". The future policy in this respect depends entirely on developments and the maintenance of the company's sound financial position. Assets are \$3,653,256 as compared with \$3,893,463 a year ago.

Max Morgenstern, minority shareholder in the Buffalo mine, has failed in his application for an injunction restraining the passing of a by-law authorizing the sale of the assets of the Buffalo to the Mining Corporation of Canada for \$462,000. The application was dismissed in the absence of any fraudulent intent being established.

A plan is under way with the object of merging the Adanac property with the Victory Silver Mines. The latter was formerly known as the Hylands property and is situated about 660 ft. south of the Adanac. It is proposed to incorporate a new company with a capitalization of 2,500,000 shares; of this 1,000,000 shares is to go to the Victory and 1,000,000 to the Adanac shareholders, and the remainder to be marketed as a means of financing further work.

PORCUPINE.—No official information as to the operations of the Dome Mines has been forthcoming for some months, and the policy of reticence pursued by the management is unsatisfactory to some of the large shareholders. A party of directors will visit the property before the end of the month, and it is hoped that some definite information will then be made public. As far as can be learned the working force has latterly been somewhat increased and now numbers between 300 and 400 men, the mill continuing to operate at about two-thirds capacity with mill-head running from \$7 to \$9 per ton. The Hollinger Consolidated according to official statements has about 1100 men on the payroll and is treating an average of approximately 2300 tons of ore per day with a recovery of about \$4.77 per ton. Work during the past year was confined to the workings above the 800-ft. level. The program for development includes the establishment of electric haulage-levels at the 650-ft. and 800-ft. levels in addition to that already on the 500-ft. level. At the Clifton-Porcupine electricity will be turned on about March 1. A cross-cut will be run about 800 ft. in length, east and west of present workings on the 200-ft. level to cut eleven veins which have been found to parallel each other. A considerable tonnage of good ore is said to have been blocked out.

KIEKLAND LAKE.—W. Green and associates who have large investments in the camp, have secured an option on a controlling interest in the Montreal-Kirkland. Some good veins are in evidence including one 18 in. wide of \$12 ore. The shaft of the Fidelity has been pumped out and development will be undertaken on the main vein at a vertical depth of 100 ft., where a start had been made when work was stopped by the strike. The vein, 22 in. wide on the surface, had widened to 7 ft. at the bottom of the shaft.

THE MINING SUMMARY



ALASKA

Anchorage.—The Bank of Anchorage is in receipt of advice confirming the sale of the Gold Bullion mine, in the Willow Creek district, to a syndicate of Canadian capitalists, for a consideration of \$500,000. The new owners plan to install an extensive power-plant on the Little Susitna that will not only furnish power for the Gold Bullion, but it is understood will connect with other operating quartz-mines in the district. The Gold Bullion property consists of fourteen claims located on Willow and Craigy creeks, in the heart of the famous new quartz camp. Original discovery on the Gold Bullion was made in 1905.

CALIFORNIA

Darwin.—The Darwin Development Co. has resumed work on the Lucky Jim group with 27 men. The shaft is being repaired and arrangements made for further development at depth. Shipping and milling-ore is exposed on the lower levels. Satisfactory development will be followed by the erection of a concentrator and cyanide plant.—The Christmas Gift group, adjoining the Lucky Jim on the south, has passed to the control of the Watterson syndicate, of Bishop, and is being placed in shape for production. The ore contains silver and lead. The Watterson interests have also secured control of the Stevens property. Negotiations are pending with the Tonopah Mining Co. for treatment of the product at Millers, but shipment of the high-grade ore to California and Utah smelters will continue.

Forest.—Sinking on a promising ore-shoot has begun at Kate Hardy mine, where a shaft is being sent to the 200-ft. point. Driving of a tunnel is proceeding with the purpose of reaching the end-lines of the Kate Hardy and Derelict claims. Some good ore has been found. New mine equipment, including an Ingersoll-Rand compressor and Jack-hamer drills, has been purchased. The small mill will be started shortly, and a large plant is planned for erection in the summer.

Keeler.—The Cerro Gordo Mines Co. has resumed work on the Santa Maria group and has opened in a winze a 5-ft. vein of silver-lead-copper ore. Shipments are sent over the five-mile aerial tramline to Keeler, and thence to Utah smelters. Other discoveries have been made recently in the mine.—The Estelle Mining Co. has begun shipments after 20 years of development. An aerial tramline, 7100 ft. long, has been built from the portal of the Morning Star tunnel to the ore-loading station on the Keeler road. The main tunnel, 2200 ft. below the Morning Star lateral, is over 7300 ft. long and penetrates the property at an approximate vertical depth of 3500 ft.—The Santa Rosa Co. reports the opening of a full face of \$50 ore beyond the dike, supposed by former lessees to mark the end of the vein. Shipments are going forward to custom plants.

Lincoln.—The Montezuma Mines Co. has driven a new cross-cut tunnel 880 ft. long and expects to reach the ore-body within 400 ft. Shipments of oxidized ore from the surface workings continue, but the concentrator has been shut down pending completion of the new tunnel.—The Base Metals Co. is sinking a 600-ft. shaft at the Bunker Hill mine to reach a new ore-zone believed to occur at this depth.

Shipping ore continues to be mined from the 150-ft. workings.

Mokelumne Hill.—Grading for the 100-ton mill at Boston mine has been completed and erection of the building begun. Large reserves of ore are blocked out it is said.—Dewatering of the Easy Bird mine has been finished and equipment is arriving. It is understood locally that comprehensive development work will commence shortly.

Shasta County.—The Afterthought Copper Co. has suspended all work on the Afterthought mine and drawn the pumps. It is cleaning up preparatory to closing the reverberatory furnace and the oil-flotation plants. For several months Ingot has been the liveliest copper camp in the county. It is not announced how long the present shut-down is likely to last.

IDAHO

Coeur d'Alene.—The Hercules and Tamarack mines, controlled by the Day interests, have started shipping ore to the Bunker Hill smelter at Kellogg. It is rumored that the Days have decided to ship all their ore from their Coeur d'Alene mines to the Bunker Hill, and abandon the Northport plant. Since the strike at the Northport smelter the Bunker Hill company has rushed work in adding to its smelting facilities and it is said that the capacity has been increased 1000 tons per day. This is just about the daily output of the Tamarack and Hercules mines.—A 10-ft. vein has been uncovered in the east drift on the 2000-ft. level of the Hecla mine, according to report. Three feet of the ore is high grade, and the remainder good milling grade, it is said. This ore is on the original Hecla vein and is not involved in the present litigation.

Moscow.—Francis A. Thomson, dean of the school of mines, at the University of Idaho, announces a special conference or post-graduate course for experienced mining men explaining the several phases of the flotation treatment of ores.

Among those who have been assigned places on the program are: Thomas Varley, superintendent of the United States Bureau of Mines at Salt Lake City; C. A. Wright, hydro-metallurgist at the Bureau of Mines station at Salt Lake City; M. S. Sullivan, superintendent of the Bunker Hill smelter; W. L. Ziegler, of Spokane, flotation engineer; and W. L. Penick, of Spokane, metallurgical engineer of the Hardinge Conical Mill Company.

MISSOURI

Webb City.—The new 200-ton mill being erected by T. F. Coyne on the lease he recently procured on the Connor land south-east of Webb City, will be completed and ready for operation within six weeks. The mill will cost about \$30,000. Coyne bought the lease from the Webb City & Carterville Development Co., which was organized as a community drilling project. He paid \$16,000 in cash for the lease, with 15% royalty, which is a 5% increase for the drilling company. Since obtaining the lease two shafts have been sunk, rich lead ore being found at shallow depths.

MONTANA

Butte.—The report of the Butte & Superior Mining Co. for the fourth quarter of 1919 makes possible a survey of

the year's operations. Up to the last of October, the zinc market had been drifting in the same aimless manner it had been pursuing for the past two years. With the advent of winter, however, came a stiffening in price, and the average sales-figure of Butte & Superior for the final quarter was 8½c. per pound, an increase of one cent over the preceding three months.

Net profits for the quarter amounted to \$566,980, equivalent to \$1.95 per share on the 290,184 shares outstanding. This brought the total profits for the year up to \$1,077,493, or \$3.31 per share, 60% of which was contributed by the last three months. These earnings are after taxes and depreciation but before depletion of ore has been provided for.

A very significant and encouraging feature of the last quarterly report was the manner in which the percentage of recovery stood up, notwithstanding the company under Supreme Court mandate was compelled to increase the amount of oil it uses in the flotation process. Average recovery was 93.84% of the zinc in the ore, a decline of but 2% from the preceding 3 months, while the average for the year was 95.6%, an increase of 3% over 1918 and 5% over 1917.

The following table sets forth the salient features of the past three years' operations:

	1919	1918	1917
Tons milled	402,436	468,814	461,953
Average assay zinc, per cent.	14.7	15.9	15.4
Recovery, per cent.	95.6	92.96	91.13
Zinc produced, lb.	113,387,464	138,841,739	131,337,329
Profits per share.	\$3.31	\$2.16	\$6.85
Total costs per ton.	\$9.97	\$11.38	\$9.84

It was understood that the company had \$2,500,000 in net quick assets at the close of 1919, and should the zinc market hold its present firmness it is not improbable that dividends will be resumed regardless of the final accounting to Minerals Separation.

NEW MEXICO

Chino.—At a meeting of the Board of Directors of the Chino Copper Co. a quarterly dividend of 37½c. per share was declared, payable March 31. This will call for a total disbursement of \$326,242. The last quarterly dividend was 75c. per share, which rate was maintained throughout 1919.

WASHINGTON

Danville.—The LeFlour Mountain Copper Co. will resume operations at once, according to W. H. Glunt, formerly of Wallace, who will act as foreman and superintendent. Mr. Glunt says that \$10,000 worth of new machinery has been purchased and that about 12 men will be employed.

MEXICO

The following is quoted from Samuel Montagu & Co. of London:

"The production of silver in Mexico in 1918 was 62,225,344 oz., and the production from January to September 1919 was 46,948,621 oz. It is estimated that the silver production of Mexico for 1919 was about 75,000,000 oz., of which about 3,000,000 was retained in Mexico for coinage, leaving a net export to the United States and elsewhere of 72,000,000 oz. Practically all went to the United States. In addition to the above, it is estimated that about 2,000,000 oz. was exported in the form of coins, which, however, cannot be included in the 1919 production. On November 12, 1919, a decree was issued requiring 50% of the fine silver to be delivered to the Government for coinage, to be paid for on the basis of the New York official price, less shipping expenses and taxes. Owing, however, to the high price of silver, the Government could not afford to continue coining, and since then no more has been taken to the mint. The Government still reserves the right to take 50% of the fine silver produced here. About 40% of the total production is exported as fine silver, the balance in a less concentrated form. The estimated production for 1920 is 80,000,000 ounces."

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Francis Drake writes from Algeria.

Charles Butters is expected in San Francisco on his return from Copala, Mexico.

Henry E. Wood, of Denver, is spending a couple of months at Freeport, Louisiana.

E. Perry Crawford, of Culiacan, Mexico, has returned to Silver City, New Mexico.

C. B. Lakenan, general manager for the Nevada Consolidated Copper Co., is in New York.

Harry Darling, manager of the Porcupine-Crown mine, has returned to Timmins, Ontario.

Blamey Stevens is now with the S. A. de Minas y Montes, at Triunfo, Baja California, Mexico.

E. Shinkai, New York representative of the Furukawa Mining Co., has been in Utah recently.

M. M. Duncan, vice-president and general manager of the Cleveland-Cliffs Iron Co., is in Florida.

Roy B. Earling has joined the staff of the U. S. Smelting, Refining & Mining Co., with headquarters at Boston.

Edwin E. Chase and **R. L. Chase** have moved their offices to 207 Colorado National Bank Bldg., at Denver, Colorado.

C. R. McCollom has returned to private practice at Los Angeles, giving particular attention to the petroleum industry.

Benjamin F. Tibby passed through San Francisco on his way to Los Angeles this week. He is now engaged in the oil industry.

E. H. Dudley and **L. V. Lawhed** have been examining properties near Lordsburg, New Mexico, for the Phelps Dodge Corporation.

R. C. Gosrow has opened an office at 701 Claus Spreckles Bldg., San Francisco, as metallurgical engineer and electro-metallurgist.

P. R. Hines, sales engineer of the mining department of Allis-Chalmers Mfg. Co., passed through San Francisco on his return from Vladivostok.

A. H. Fay has resigned as mining engineer to the U. S. Bureau of Mines, and can be reached at 3224 Oliver St., Chevy Chase, Washington, D. C.

Stephen Royce will have his headquarters at Crystal Falls, Michigan, where he will take care of the interests of the Jackson and Nevada mining companies.

Samuel W. Cohen, general manager for the Bluestone M. & S. Co., at Mason, Nevada, has returned to Montreal, after an examination of the company's property.

D. D. Moffat, consulting engineer of mills for the Jackling copper properties, has returned to Salt Lake City after an inspection of the Ray and Chino concentrating plants.

Alexander Mackay, president of the Dundee-Arizona Copper Co., and his son **F. B. Mackay** of Dundee, Scotland, have been inspecting the company's property at Jerome, Arizona.

T. Kaneda and **A. Sakanouye**, engineers associated with the Nippon Seimi Fertilizer Co., a subsidiary of Furukawa & Co., at Tokyo, have been visiting mining and metallurgical plants in Utah. They are now in New York.

Ray A. Corcoran, mine superintendent for the Santa Gertrudis company, at Pachuca, Mexico, was shot and killed at Pachuca on February 28.

THE METAL MARKET



METAL PRICES

San Francisco, March 2

Aluminum-dust, cents per pound.....	65
Antimony cents per pound.....	12.00
Copper electrolytic cents per pound.....	19.00
Lead, pur. cents per pound.....	9.35-10.25
Platinum, pur. per ounce.....	\$150
Platinum, 1000 ridium per ounce.....	\$175
Quicksilver per flask of 75 lb.....	\$85
Spelter cents per pound.....	11.00
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 1—Copper is quiet and easier. Lead is very strong. Zinc is quiet and lower.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

	New York	London		Average week ending	
Date	cents	pence		Cents	Pence
Feb. 24.....	129.00	82.00	Jan. 20.....	132.04	78.81
" 25.....	129.25	82.37	" 20.....	132.58	80.00
" 26.....	129.50	82.25	Feb. 2.....	134.37	83.83
" 27.....	129.75	82.75	" 9.....	132.50	87.69
" 28.....	130.00	83.12	" 16.....	132.10	85.72
" 29 Sunday.....			" 23.....	130.00	83.55
Mch. 1.....	131.75	84.00	Mch. 1.....	129.87	82.75

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	....	Sept.	101.12	113.92	....
Apr.	85.35	101.12	....	Oct.	101.12	119.10	....
May	89.50	107.23	....	Nov.	101.12	127.57	....
June	89.50	110.50	....	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Feb. 24.....	19.12	Jan. 20.....	19.16
" 25.....	19.12	" 26.....	19.08
" 26.....	19.00	Feb. 2.....	19.23
" 27.....	19.00	" 9.....	19.12
" 28.....	18.87	" 16.....	19.00
" 29 Sunday.....		" 23.....	19.02
Mch. 1.....	18.75	Mch. 1.....	18.81

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	....	Sept.	26.00	22.10	....
Apr.	23.50	15.23	....	Oct.	26.00	21.66	....
May	23.50	15.91	....	Nov.	26.00	20.45	....
June	23.50	17.53	....	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Feb. 24.....	9.00	Jan. 20.....	8.75
" 25.....	9.12	" 26.....	8.75
" 26.....	9.12	Feb. 2.....	8.75
" 27.....	9.25	" 9.....	8.75
" 28.....	9.25	" 16.....	8.75
" 29 Sunday.....		" 23.....	8.92
Mch. 1.....	9.37	Mch. 1.....	9.18

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	....	Sept.	8.05	6.02	....
Apr.	6.99	5.05	....	Oct.	8.05	6.40	....
May	6.88	5.04	....	Nov.	8.05	6.76	....
June	7.59	5.32	....	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound:

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	....	Aug.	91.33	62.20	....
Mch.	85.00	72.50	....	Sept.	80.40	55.79	....
Apr.	88.53	72.50	....	Oct.	78.82	54.82	....
May	100.01	72.50	....	Nov.	73.67	54.17	....
June	91.00	71.83	....	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date		Average week ending	
Feb. 24.....	9.35	Jan. 20.....	9.50
" 25.....	9.35	" 26.....	9.54
" 26.....	9.20	Feb. 2.....	9.41
" 27.....	9.10	" 9.....	9.07
" 28.....	9.10	" 16.....	9.06
" 29 Sunday.....		" 23.....	9.25
Mch. 1.....	9.10	Mch. 1.....	9.20

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	....	Sept.	9.58	7.57	....
Apr.	7.04	6.49	....	Oct.	9.11	7.83	....
May	7.92	6.43	....	Nov.	8.75	8.12	....
June	7.92	6.91	....	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Feb. 3.....	85.00	Feb. 17.....	80.00
" 10.....	80.00	" 24.....	80.00
		Mch. 2.....	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.00	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	....	Sept.	120.00	102.60	....
Apr.	115.00	73.12	....	Oct.	120.00	86.00	....
May	110.00	84.80	....	Nov.	120.00	78.00	....
June	112.00	84.40	....	Dec.	115.00	85.00	....

MONEY AND EXCHANGE

Commerce reports do not yet show the anticipated effect of foreign exchange depreciation, in diminishing the volume of our exports. As the 'Boston News Bureau' points out, up to the end of January there had been no such decrease in our export totals, although the counter effect of a stimulus to imports had become fairly pronounced. It takes time for financial impediments to reach expression in cargo terms, and goods continue, for a considerable interval, to flow out on old orders. Likewise a shifting in character of sales may make good considerable losses in some respects. The February figures may tell a different story, inasmuch as actual freight conditions are known to have changed radically during that month.

January managed to set, at \$731,000,000, a new export record for that month, by a margin of \$108,000,000 over the former January high point in 1918. Aside from the exceptional peak of \$928,000,000 attained last June, it is within some \$10,000,000 of the former monthly high level, made last November. In the 15 months since the Armistice, a period during which a pronounced drop from wartime totals was predicted by many, the monthly export average has been \$650,000,000, with the largest records in the more recent months. In the prior 15 months of war the corresponding average was only \$512,000,000.

The destinations of some of our recently increased exports explain a good deal and also suggest some doubt of permanence in some of the new totals. One obvious reason for continued increase lies in the comparison of resumed, if still small, exports to the Teuton alliance, as against nothing permitted under the blockade. Thus in 1919 our new sales to the Teutonic confederacy uniformly increased to such an extent that for the year they totaled almost \$160,000,000.

Still more conspicuous have been the recent gains in our sales to near neighbors of Germany which during wartime were severely restricted. During 1919 our aggregate sales to Belgium, Denmark, Holland, Sweden, and Norway were no less than \$1,065,000,000, as against only \$230,000,000 in 1918. That huge increase meant the supplying of deficiencies, and naturally cannot be maintained. In fact, many warehouses in those countries are reported bulging now with unsold Yankee goods, shipped there during recent months.

January imports at \$474,000,000 set both a new record for that month by \$232,000,000 and a new record for any month by a margin of almost \$40,000,000 over last September. The manner in which imports have lately crept steadily upward has also been notable. In 1918 they varied little from an average of \$250,000,000 per month, and maintained that pace for the first third of 1919.

There is significance in the changing character of our commerce. In 1919 the proportion of crude materials for manufacturing exported rose to 20.78% of the total exports, getting as high as 33% in December. In 1917 the same percentage was only 12.65%. Conversely our sales of finished or partly finished manufactured goods have fallen from 65% to 45% of total exports between 1917 and 1919. Europe is buying discriminately, with a view to future sales to us.

Foreign quotations on March 2 are as follows:

Sterling, dollars:	Cable	3.45
	Demand	3.44
Francs, cents:	Cable	7.04
	Demand	7.03
Lire, cents:	Demand	5.49
Marks, cents		1.05

Eastern Metal Market

New York, February 25.

The markets are generally more active, stronger, and higher.

Copper demand has improved somewhat but prices are unchanged. They are firm with a strong tone.

Tin prices have advanced with the betterment in exchange and in values in the London market.

Demand for lead continues to gather strength and prices are higher.

Buying of zinc has increased and inquiry is expanding with an advance in prices.

Antimony is quiet but steady.

IRON AND STEEL

The steel trade is now particularly interested in the extent of prospective buying by the railroads. Already the New York Central is inquiring for 150 locomotives and 13,200 box-cars and the Rock Island for 35 locomotives and 3250 cars. The Union Pacific has bought 102 locomotives and the St. Paul wants 100, while the Great Northern has ordered 1000 cars and the Soo Line 300.

Steel producers do not show yet much inclination to open their books for forward business, and in contrast to this may be cited a tendency here and there on the part of consumers to take their chances in waiting for lower prices. The decision of one prominent producer to sell for second quarter may signify the end of price advances, as these orders will be taken at 4c. for plates, shapes, and bars. There are signs that the bulk of third-quarter delivery purchases yet to be made will be at higher prices than are now the average, possibly \$2 per ton above war-level prices.

COPPER

Conditions have changed but little; but for the better. Demand is slightly better with a little more inquiry for electrolytic and some light business reported. There has also been some improvement in export demand and in export conditions in general. Electrolytic is quoted by most producers at 19c. to 19.12½c. for early or first-quarter delivery, with second-quarter held at 19.25c., New York. Lake is slightly stronger at 19.25c. to 19.37½c., New York. Second-quarter deliveries are about ½c. higher. Producers and sellers look forward confidently to better demand in the spring and summer both from domestic and foreign consumers.

TIN

The market here has steadily advanced until today spot Straits is quoted at 64c., New York, with futures held at around 65.50c. Transactions have been only moderate for any delivery and the business that has been done has been mostly between dealers. Another important factor in the advancing market here has been the spectacular advance in the London market. Tin has gone to over £400 per ton and yesterday reached £415 10s. for spot Straits with £418 for futures, the highest levels ever reached. The previous high level was £399 per ton last August. In the local market here, there appears to be less desire on the part of leading sellers to sell and the statistical position is growing stronger all the time with the metal concentrating in stronger hands, as noted a week ago. It is expected by some that the New York market will follow that of London from now on. For the first time in many months or even years, dealing in tin was reported last Friday on the New York Metal Exchange. Arrivals thus far this month have been 4395 tons, with the quantity afloat 3770 tons.

LEAD

Instead of production tending to overtake demand, as

predicted by a few some time ago, the opposite seems to be the tendency. Demand is heavier and prices are advancing. Yesterday the American Smelting & Refining Co. advanced its price from 8.75c. to 9c., New York, to which level the outside market had already risen late last week. We quote the outside market and the "Trust" price as 8.75c., St. Louis, or 9c., New York, for early delivery, with the likelihood that the former will soon pass the latter. It is stated that the metal could be sold as high as 9.75c., for delivery in the second quarter and that inquiry is very good. Foreign demand is a factor also and may so continue, for the usual foreign supplies are not as plentiful as some years ago. In the last two weeks the London market has advanced £2 10s. per ton, or from £49 15s. to £52 5s. per ton.

ZINC

In the past week demand and buying has improved and the tone of the market is stronger and better. With the upward movement in exchange value, there appeared last week a buying movement of moderate proportions from foreign buyers, and fair quantities were sold on a scale upward from 8.75c. to 9c., St. Louis, for delivery into the second quarter. In the domestic market, galvanizers and brass-makers have been buyers for early delivery and today at least seven large galvanizers are inquiring for quantities ranging up to 400 tons, each for delivery during the second quarter. Quotations consequently have advanced steadily until today prime Western is quoted at a minimum of 9c., St. Louis, or 9.35c., New York, for early and second-quarter delivery.

ANTIMONY

The market is quiet and unchanged but strong with wholesale lots for early delivery quoted at 11.62½c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted at 31.50c. to 33c. in wholesale lots for early delivery, depending on whether bought from the leading interest or the outside market, the higher level applying to the former.

ORES

Tungsten: The decision of the tariff question is all absorbing just now and as a consequence the market is inactive and prices are nominal at \$6 to \$15 per unit, depending on the grade of ore and delivery. Ferro-tungsten is quoted in one case at 95c. to \$1 per pound of contained tungsten, but very little business is heard of.

Molybdenum: The market is quiet and prices are unchanged and nominal at 75c. per pound of MoS₂ in regular concentrates.

Manganese: The foreign ore mentioned a week or so ago as being offered at \$1 per unit is now obtainable at 80c., but no sales are recorded. The question of shipping is the important one and is apparently holding up deliveries. It is also calculated that at \$1 per unit, ferro-manganese producers could not break even at present prices, estimating 2½ tons of ore to 1 ton of alloy.

Manganese-Iron Alloys: Spot ferro-manganese is very scarce and much higher. Sales have been made at both \$200 and \$225, delivered, and demand for odd lots is insistent. Some consumers are hard put for supplies. British alloy is scarce with little available. Sales have been made for second quarter at \$65, seaboard. American producers are asking \$170 for third quarter, and \$160, delivered, for last half. Spiegeleisen is quiet but very strong at \$57 to \$60, furnace, the higher price holding for nearby deliveries.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

GASOLINE-ENGINE DRIVEN GENERATOR SETS

The requirements of the Army during the War brought particular emphasis to the fact that for certain work and conditions an independent portable source of power and light is desirable. Gasoline-engine driven generators of various sizes were employed extensively to great advantage.

The Allis-Chalmers Manufacturing Co. furnished a large number of these sets to the Government and their success in operation under the exacting conditions has thoroughly demonstrated their reliability as apparatus for general use.

Two sizes have recently been placed on the market: 5-kw., 110 or 220 volts, and 15-kw., 110 or 220 volts.

These sets employ four-cylinder, four-cycle gasoline en-

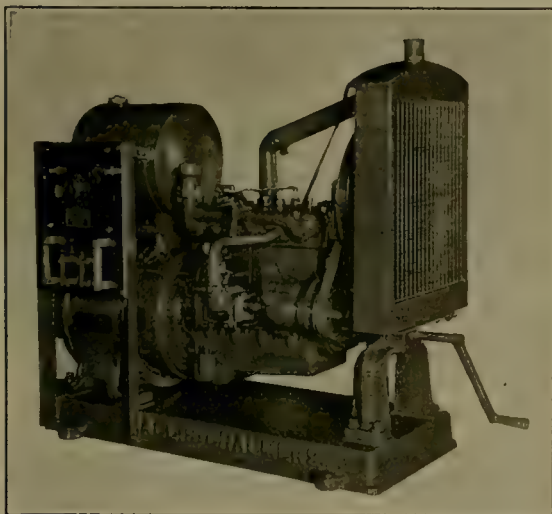
generator frames. A coupling on the generator shaft fits into a recess in the flywheel and is bolted rigidly to it. The flywheel and coupling are enclosed in the barrel housing. This construction gives a very compact arrangement and one in which the bearing alignment does not depend upon the rigidity of the base casting and foundation. In this set the gasoline-tank is mounted above the generators with gravity feed to the carburetor. The switchboard is mounted on angle irons attached to the base casting.

The 15-kw. set is in some respects different in construction from the 5-kw. set. The generator is provided with front and rear bearing-housings and is coupled to the engine by means of a flexible coupling. The gasoline-tank is rectangular in form and is mounted in the base under the engine. The gasoline is raised to the carburetor by means of a vacuum system similar to that widely used in automobile construction. In this set the switchboard is separately mounted and may be placed in any convenient position.

These sets make available a source of power and light which is flexible in application and comparatively cheap. Even in localities where electricity is available it will be found cheaper and more expedient in many cases to have an independent portable source of power and light. Central stations usually exact a charge for installing a meter and wiring and a minimum rate for electricity.

Concrete-mixers, hoists, centrifugal pumps, reciprocating pumps, air-compressors, and many other types of machinery can be economically and efficiently operated by electricity.

Without an independent portable source of electric power, the use of the most efficient electrically operated tools and equipment is impractical because of the uncertainty of being able to get electricity at all, because the voltage or frequency may be different in different places, and because of the delay and expense in getting meters and wiring from supply circuits installed.



5-kw., 110-volt Generator Driven by Gasoline Engine

gines of the automobile type, which are of ample size and rating to withstand continuous full-load service without being over-taxed. The engines will carry momentary overloads up to the ultimate capacity of generators without bringing undue mechanical strain on any of the working parts. They are equipped with standard magnetos, carburetors, water-circulating pumps, tubular-type radiators, and fans. Governors are provided which positively regulate the speed to within 4% of the set speed of the engine from no load to full load. The generators are provided with compound windings proportioned so that the voltage variations do not exceed 2% from the set voltage from no load to full load.

The 5-kw. set shown in the photograph has three main bearings; one being the standard ring-oiled generator bearing, the other two being in the frame of the engine. The generator is held in accurate alignment by a rigid barrel housing which is machined to fit shoulders on the motor and

FLEXIBLE SHAFTING

The Stow Manufacturing Co. of Binghamton, New York, builder of portable tools, is distributing a valuable booklet entitled 'Flexible Shaft'. A dozen special uses of flexible shafting are discussed and some general information regarding its manufacture and utility is given. The following is quoted from Bulletin No. 104:

"Flexible shafting consists essentially of an inner core constructed of built-up wire coils and a protecting casting with bearings and suitable fittings for the transmission of power from some source such as an electric motor, counter-shaft, or engine to the tool. The core in the shaft is brazed or soldered into end fittings, assembled in a reinforced leather or metal casing which supports the bearings, and is held in the case in such a way that when the shaft is bent no strain will come longitudinally on the core. This is very important, since the cores are not designed to resist end pull. The design of flexible shafts usually includes a sliding connection of some kind to take care of this feature.

"Flexible shafting does not compare with the solid shafting in the matter of strength, since this must be sacrificed

to obtain flexibility. The bearings must be constructed to withstand harder usage than those for solid shafts, due to the vibration which follows from the design and which cannot be eliminated. However, in spite of these disadvantages the flexible shaft finds many applications where the solid shaft could not be used. The standard shaft is designed to run clockwise and will transmit only two-thirds of its normal power when operated in the reverse direction. Shafts may be obtained, however, for left-hand operation. Keep flexible shafts and tools well oiled. The flexible shaft is a bearing for its entire length and should be treated accordingly. To oil, use unsalted tallow, lard oil, or animal oil. Never use mineral oil, especially when leather or fabric cover is used, as such oil has a tendency to rot it. When oiling, disassemble shaft, remove the core, and immerse in the lubricant, taking care not to subject the core to rough handling while out of its bearings. Examine the shaft thoroughly each day. Avoid sharp bends and support it as much as possible. If the shaft begins to buckle it is overloaded, and the only remedy is to relieve it at once."

A PERMANENT MACHINERY EXPOSITION AND SALES-CENTRE

By Howard R. Ward

The number of machinery manufacturers in the United States has increased largely in the last few years. Plants are now found in almost all sections of the country. Machinery has not only greatly increased in diversity, but a similar expansion has also taken place in the manufacture of appliances and supplies. The products of these manufacturers are sold not only in America but in most parts of the world.

Many channels are used to bring these products to the notice of prospective consumers: advertising in the trade journals which have become effective channels of information in their various fields; extensive use of technical salesmen; advertising in the popular journals; circularization; personal correspondence. The methods have in fact become so numerous and the market so wide that the manufacturer cannot take advantage of them all and finds it necessary to choose only certain fields and to limit his methods of reaching those fields.

The consumer is in much the same position. Formerly he was in close touch with the one or two concerns which were the only ones who could supply him with the machinery and supplies that he used in his business. Today in attempting to secure what is best suited to his needs, he must study all appropriate advertising mediums, he frequently travels extensively to visit manufacturing plants, and he must keep the data he collects in available shape, and up to date.

One possible solution of the increasingly difficult problem is to establish a permanent exposition and sales centre at a point as mutually convenient as possible for the manufacturer and for the domestic and foreign consumer. A sales-centre for machinery and kindred appliances and products, once permanently established in a proper location, would unquestionably be of value to both the manufacturer and the consumers. Though some attempts have been made that have resulted in failure, the reason has always been evident; either the scope was too limited or the location was not central or convenient. Some attempts have succeeded in foreign cities and also in this country, but in all cases their success or lack of success has been governed by their location and scope.

New York city has become more and more the logical place for a permanent sales-centre. It is visited regularly by manufacturers, operators, buyers, and engineers from all parts of the world. The Grand Central Palace, a twelve-story reinforced-concrete building, occupying an entire block,

is to become just such a sales-centre. Eight floors, each containing approximately 50,000 sq. ft. of floor space, are to be devoted to the permanent display of machinery, mechanical appliances, and all allied products. The lower floors will continue to be used as heretofore for short-term expositions such as the Chemical Exposition, Automobile Show, and the like. The location of this building, in the Grand Central zone, is ideal. It is within close reach of the railway terminals, the hotel district, and technical libraries.

This permanent exhibit will be known as the 'International Exposition of Industries', and its scope on mechanical lines will be extremely broad and comprehensive. Exhibits will include farm tractors and mining equipment, construction machinery, and other commodities. It will cover the widest possible range of mechanical devices. The mining section will include machinery and appliances for the production of coal, metals, minerals, and petroleum. In other sections will be found machinery and devices used in the various mining industries but not manufactured primarily for these fields.

In working out the details of the project the organizers have kept in mind certain important factors. It was realized that the cost of exhibiting should be kept as low as possible and that the service given the exhibitors should be worth more than the cost of exhibiting. The services usually found in all up-to-date office buildings will be available, and will include elevator service, janitor service, light, heat, and power. In addition to these services, attendants will be stationed on each floor. These attendants will be technical, practical, experienced men, able to explain to visitors the purpose and method of operation of the appliances exhibited. As a result of this service it will not be necessary for manufacturers to keep their own technical salesmen in attendance. When visitors are found to be in the market for immediate purchases they will be placed in touch with the manufacturers' salesman. The institution of this permanent exhibit and sales-centre in the Grand Central Palace will offer many advantages to exhibitors besides the benefit of a central point for exhibition, demonstration, and sale of their products. The great value of interchange of thought in industrial efforts is now well recognized and the 'International Exposition of Industries' will give this stimulus to manufacturers, engineers, operators, and consumers. It will not only bring direct benefits to producers and consumers, but will result in broadening and stimulating the fields and efforts of each industry.

COMMERCIAL PARAGRAPHS

Robert T. Banks, formerly of El Paso, is now Northwestern manager for the Sullivan Machinery Co. at Spokane, succeeding L. R. Chadwick, who has been placed in charge of the New York office of the same company.

The Traylor Engineering & Manufacturing Co. through its Los Angeles office has sold to the Burma Mines, Ltd., for shipment to India, five sets of 54 by 24 in. Traylor AA heavy-duty crushing-rolls, and one set of 36 by 14 in. rolls of similar type, as well as a steam-driven air-compressor and a complete 'cement-gun' outfit. The same office has also sold to the Mountain Copper Co. of California, two sets of 42 by 16 in. rolls.

During the past few years many articles have been written giving the history of the steam-turbine and describing its rapid advance from the experimental stage to its present position as one of the principle prime movers. The design and construction of the blading are of prime importance and the engineering and shop organizations of the Allis-Chalmers Manufacturing Co. have devoted much time and energy to this feature of construction. Bulletin No. 1104 is an instructive publication detailing the growth in the technique of the manufacture of these blades, and the improvements made to date.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MARCH 13, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	EDITORIAL	Page
NOTES		363
HENNEN JENNINGS		364
The end of a great mining career. His high character and public spirit. The close of an epoch.		
THAWING FROZEN GROUND WITH COLD WATER.		364
Experiments made at Nome to prove that cold water is more effective than superheated steam for thawing frozen gravel, as demonstrated by J. H. Miles. Scientific analysis, and confirmation, of these results by Professor Weeks of the University of California.		
THE NOMINATION OF HOOVER.....		365
The engineers of San Francisco organize a Hoover Republican club to promote the election at the forthcoming primary of delegates pledged to Hoover. The primary law. Personnel of the club. Significance of the event.		
THE PREMIUM ON GOLD.....		365
Increased dividends from the mines of the Rand is due to the premium on gold at London. Statistical data. Effect of the premium on current profits. Article by H. S. Denny in the 'Financial Times'. Possible profits if gold should sell at 130 shillings per ounce. The revival in speculation. The Indian gold mines and the premium. Rupee exchange. How conditions differ from those in South Africa. Other anomalies of exchange. Need for an international financial conference.		

ARTICLES

THAWING FROZEN GRAVEL WITH COLD WATER	
By Walter S. Weeks.....	367
Report on experiments in thawing made by John H. Miles at Nome. Use of super-heated steam; saturated steam; warm water; and cold water. Comparative results. Technical comparison based on heat-units involved. Theoretical efficiencies. Advantages of cold water.	
THE DISTILLATION OF SHALE-OIL	
By James A. Bishop.....	371
Kerogen in oil-shale. Constructive v. destructive	

distillation. Eduction products. Three grades of distillates. Fractioning the three grades. 'Cracking'. Viscosity retards distillation. The use of steam. Requirements of a successful distil.

NEUTRALIZING MINE-WATERS ON THE RAND

By F. Wartenweiler and E. H. Croghan..... 376
Four objects in the neutralization of acid mine-water. The process from a metallurgical standpoint. Reagents used in underground settling. Rate of settlement. Recovery of gold in sludge by cyanide treatment. Interesting problems remain.

MAGNETIC SEPARATION OF BISMUTH, TIN, AND TUNGSTEN CONCENTRATES IN TASMANIA

By Wm. E. Hitchcock and J. R. Pound..... 379
The Wetherill process. Conditions for satisfactory operation. The treatment required at Launceston on complex material containing bismuthite, cassiterite, and wolframite, which are the minerals of economic importance. Concentrates 'cleaned' after roasting to convert pyrite. Details of the roasting process. Sundry applications of the process to custom ores.

SPEECH BY MR. HOOVER BEFORE THE WESTERN SOCIETY OF ENGINEERS, AT CHICAGO, ON FEBRUARY 28

383
The growth in production of non-food commodities, as compared with agricultural industry. Our chief export used to be food. The first reconstruction problem deals with agriculture. Our system of distribution. Weaknesses and remedies. The 'middle man'. Co-operative marketing not socialism. Improved machinery. Organization of production and distribution of food products.

NOTES

HELIUM	378
--------------	-----

DEPARTMENTS

REVIEW OF MINING	387
THE MINING SUMMARY	395
PERSONAL	396
OBITUARY	396
THE METAL MARKET	397
EASTERN METAL MARKET	398
INDUSTRIAL PROGRESS	399

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



The Trouble Chasers

NEVER *looking* for trouble but very much on the job whenever, *wherever* needed!

Oxweld is the trouble chaser of industry.

There are Oxweld Sales Service Centers in more than 50 large cities. This great organization opens up to you a treasure house of oxwelding production data, ready for instant application to *your* problem in *your* plant.

A request from you will bring an Oxweld Engineer to your door in a hurry—ready to tackle your production problem and to solve it.

Write, wire or telephone to any of the addresses below for immediate attention from the nearest Service Center.

O509



OXWELD ACETYLENE COMPANY

Newark, N. J.

Chicago

Los Angeles

*World's Largest Maker of Equipment for Oxwelding
and Cutting Metals*



T. A. RICKARD, . . . Editor

ON March 6 the Democratic party in California selected an unpledged delegation to the Democratic National Convention, after Messrs. McAdoo and Hoover had asked that the delegation be not pledged to them. Mr. Hoover advised the Democratic State Committee that he was "not a candidate". This, it will be presumed, means that he is not a candidate on the Democratic ticket and thereby confirms his reply to the Democrats in Georgia; moreover, in California a Presidential candidate cannot have a pledged delegation on more than one primary ballot. On page 383 we print the speech delivered by Mr. Hoover before the Western Society of Engineers on February 28.

DISTILLATION of shale-oil is a subject of growing importance; therefore the scholarly article by Mr. James A. Bishop, of Denver, will be welcomed by the numerous mine-operators that are now engaged in the exploitation of shale as a source of oil. The nature and qualities of the compounds obtained from kerogen, the substance that makes shale valuable for the purpose, are discussed by Mr. Bishop in terms of chemistry. He compares constructive with destructive distillation and describes the chemical and physical properties of the compounds derived therefrom; these distillates are of three grades, with possibly a fourth. By fractionating at successive temperatures there are yielded a variety of commercial products of diversified usefulness. Mr. Bishop shows the need for efficiency and tonnage in making the process of shale beneficiation profitable and gives technical data of a most timely character.

LESSENING of gold production in California, as well as elsewhere, is the subject of a circular issued by Mr. Fletcher Hamilton, the State Mineralogist. He refers to the need for more gold to sustain the vast structure of credits created by the War and the necessity for strengthening the standard upon which international values are based. The United States is the only country in which no premium on gold is obtainable, he says. In 1914 the consumption of gold in the arts was \$45,520,918; in 1919 this consumption increased to \$80,337,600, as against an output in this country of \$94,531,800 in 1914 and of only \$58,488,800 in 1919, so that the amount of gold used last year in the arts, and not available as standard money, exceeded our domestic production by \$21,848,800. To correct this anomalous condition and

to stimulate the search for ore, now retarded by the high cost of labor and supplies, Mr. Hamilton advocates the imposition of an excise tax on manufactured gold for the purpose of paying a premium upon newly produced gold.

FOUR mining companies at Tonopah have adopted a plan of 'blanket' life insurance for all employees of both mines and mills, without cost to the men themselves. Each company is to have a policy with one of the large Eastern life-insurance societies that will assure the family or other beneficiary of each miner or mill-man a definite sum in case of his death from any cause, so long as he is on the payroll of the company. This is distinct from, and in addition to, any compensation provided by the State law as administered by the Industrial Commission. No physical examination is required and the insurance applies without discrimination to every man who has been employed for a minimum period of two months until such time as his service with the mining company shall have been terminated. One important feature of the arrangement is the fixation of the amount of insurance on the basis of the length of time the individual has been continuously employed. Beginning with \$500, the amount increases in several steps so that after one year the beneficiary, in case of the employee's death, will receive \$1250; and after two years, \$1500. This method recognizes, and obviously will tend to decrease, the costly practice of changing continually from one mine to another or from one district to another, which has become a habit with Western miners. This excessive turn-over is expensive to the employee no less than to the employer, so that by supplying an incentive for regular work with one company the new scheme will be a mutual benefit.

A SUBSCRIBER from Surf Inlet, British Columbia, apropos of several recent articles on ball-mill operation, writes for information as to "the proper ball-load in the mill, which we mill-men here consider as important as the feed, in grinding ore". The principal factors that influence grinding operations in a given mill are the kind of lining, the speed of rotation, the size of the balls, and the load of balls in the mill; also the dilution of the feed, size of particles, and the hardness and toughness of the ore. The nature of the product desired is a point that has a bearing on the method of operation, although the wide application of flotation has to a great extent obvi-

ated the necessity for minimizing the proportion of slime, so that the object now is almost always to get a maximum of comminution. One of two typical problems may be presented. If a preliminary test is being made on which to base the design of a plant, the question is to determine the conditions of operation that will effect the most profitable result, that is, crush the maximum amount of ore to the desired fineness with a minimum expenditure for power and for the replacement of lining and balls. The required number of mills with appropriate motors or other driving units may then be provided. On the other hand, a fixed number of mills may be available in the plant and the problem may be to operate them in such manner as to grind the maximum amount of ore, regardless of any consideration of comparative cost. A few general statements that hold good under all circumstances may now be made. If less than 25% of the volume of the mill is filled with balls, the consumption of steel, including balls and liners, is excessive. There is a constant increase in the crushing capacity as the ball-load approaches 50% of the volume, but at approximately this point the maximum is reached and the capacity thereafter diminishes. Likewise the power consumed gradually increases with additional ball-load from no load to a point where the balls occupy between 60 and 65% of the volume of the mill, beyond which the power requirements decrease. A mill that is operating at maximum economic efficiency with 40% of its volume occupied by balls may conceivably have its capacity considerably increased by the addition of sufficient balls to bring this up to 50%, presuming that the motor is able to carry the added load. It may be, however, that the cost of additional power will more than offset the gain in the quantity of ore ground; in other words, the capacity is increased at the expense of ultimate efficiency. The entire subject of grinding in ball-mills is one of timely interest. Each ore, indeed each product, that is to be ground presents a problem in itself, but accurate and reliable data from actual operations are of great value in guiding the experiments of those who are still trying to improve their practice. There is mutual advantage in the exchange of definite information based on practical results and we shall be glad to give space for that purpose.

Hennen Jennings

With deep regret we record the death of one of the leaders of the mining profession, a man of rare sagacity and public spirit. We recite the details of his career on another page. Hennen Jennings belonged to a group of mining engineers to whom the American branch of the profession owes the larger part of its reputation abroad; they were the men with experience in large-scale gold-mining operations at a time, thirty years ago, when such experience was unavailable in other countries; they had received a good technical education and were prepared therefore to adapt their methods to new conditions. They succeeded in achieving results, in making money, and in winning great reputations. Of these men Hennen Jen-

nings was distinguished by a modest demeanor and a quiet sagacity that contrasted pleasantly with the opera bouffe posturings of sundry of his compeers. He was of the co-operative type, a willing helper, and a large-minded promoter of plans for the education and welfare of the mining communities amid which he lived. His going marks the near end of a great period in the development of the profession.

Thawing Frozen Ground With Cold Water

Frozen gravel can be thawed more readily with cold water than with steam. This statement will surprise most of our readers and will cause them to read with keen interest the article by Mr. Walter S. Weeks, Associate Professor of Mining in the University of California. Mr. Weeks gives a description, by Mr. John H. Miles, of the experiments made at Nome, Alaska, and then analyzes the results on a scientific basis, confirming the facts obtained in actual practice. We have added the sketch of a 'steam-point', the pointed tube that is driven into the gold-bearing sediment and that has served as a means of introducing superheated steam for the purpose of loosening the bonds of frost. A photograph, from a drift mine in the Klondike district, shows a battery of steam-points in place with the connecting lines of hose by which steam is conducted from a boiler. Until recently the hottest steam was deemed necessary for the purpose. The discovery of the fact that frozen gravel could be disintegrated by steam was a great event. It happened in 1898 near Dawson, when Mr. J. C. Berry noticed that steam escaping from the exhaust of an engine, used for hoisting gravel, had thawed a hole in the solid 'muck', that is, the frozen mud and moss that covers so much of the sub-Arctic surface. Mr. Berry took the exhaust-pipe, which was a rubber hose, and applied it to the frozen gravel near-by; he found that it would thaw the ground for the full length of the hose within a few minutes. Those who watched the experiment were greatly excited by the result, and several of them set to work immediately to devise a method for doing such work effectively. A rifle-barrel was chosen; then a small hole was bored into one side for the admission of the steam, and thus the 'steam-point' was invented. In its rudimentary form this device became a short length of iron pipe, pointed at one end and attached to a length of rubber hose through which the steam reached the gravel from the main pipe leading to the boiler. The pointed end of the five or six feet of iron pipe was inserted into the gravel and driven forward by gentle taps from a hammer as the ground was softened by the steam issuing from the orifice at the lower end. In course of time a solid head of steel was added to the end that was hammered and a protecting ring was welded to the forward end; the shank itself was made of pipe of the strongest kind and armored rubber tubing replaced the ordinary hose. The length of the 'point' was increased to as much as 16 feet and a hole in the steel head was bored for the insertion of a bar whereby the point could be turned so as to aid its penetration of the gravel. It proved useful, but clumsy,

partly because superheated steam is not easy to manage without excessive waste of thermal energy and partly because the scope of the 'point' is restricted to a narrow range of effectiveness. This is shown in the diagram, on which the dimensions of the thaw are given for the various mediums, ranging from superheated steam to cold water. It will be seen that a 'point' supplied with cold water thawed 511 cubic yards as against 109 cubic yards thawed by superheated steam. The results obtained with saturated steam and warm water were the poorest, the thaw being measured by 83 and 81 cubic yards respectively. Mr. Weeks proceeds to explain these results in terms of thermal units and shows that whereas 4% of the total heat in the superheated steam was actually effectual in the work of thawing, 57% of the total heat in the cold water was available for the purpose. Of course, the fundamental fact is that cold water, that is, water at 52°F., is warm relatively to ice and therefore competent for thawing. We feel sure that the record of these experiments, and of their scientific basis, will prove both interesting and useful to our friends in the North.

The Nomination of Hoover

On Friday, March 5, the engineers of San Francisco met at the Engineers Club and organized the Hoover Republican Club of San Francisco Engineers. The president of the club, Mr. Ely C. Hutchinson, was temporary chairman. He introduced Mr. Charles W. Merrill as chairman, and he in turn presented Mr. James M. Hyde as the principal speaker of the meeting. Mr. Hyde, an old friend of the Food Administrator, explained that the time had come to take action in order to have a Hoover delegation nominated at the primary election on May 4. He recognized that the demand for such a nomination was non-partisan, that the engineers would vote for Mr. Hoover on any ticket, but that as a matter of practical politics it was fairly evident that at this election the vote would be overwhelmingly Republican, and that therefore it was necessary, if it was desired to elect Mr. Hoover to the Presidency, to get him nominated by the Republican party, of the State and of the Nation. He made an eloquent and convincing speech. Mr. Warren Gregory explained the primary law and the method for obtaining signatures to the necessary petition. Usually, he said, an organization was first created in behalf of a candidate and then a ground-swell of public support was evoked; in the case of Mr. Hoover the process was reversed, the public demand came first and then the organization in his behalf. All those who spoke at the meeting laid stress on the fact that they had no authority to speak for him; he was keeping aloof from active participation in the political campaign on account of the important work he was doing as vice-chairman of the Industrial Conference at Washington, a work that he considered of so great importance that he would not jeopardize his usefulness in it for any consideration. Mr. C. H. Snyder was elected president and Mr. Arthur H. Halloran secretary of the Hoover Republican Club of San Francisco Engineers and they were authorized to co-operate with similar or-

ganizations in the State so as to promote united and co-ordinated effort in behalf of the election of the next President of the United States.

This may be regarded as a significant event. It may be said emphatically of the members of our profession that they will vote for Mr. Hoover on whatever ticket his name may appear; the ordinary party cleavage is disregarded in their profound realization of the fact that he is so pre-eminently the man best fitted for the responsibilities of the Presidency at a time when those responsibilities are especially difficult and weighty; they feel keenly that ordinary political partisanship must be set aside in the effort to elect a man whose record has proved him so peculiarly adapted to steering the Nation during the troublous period of economic reconstruction to which we have come in the wake of the War; many of them have a personal knowledge of, and a consequent esteem for, Mr. Hoover so great that both as engineers and citizens they intend to sever any traditional ties with their party in order to effect his election. Indeed, it is a rare opportunity that has come to the engineering profession; at the very time when the profession was awakening to its larger duties of citizenship and was about to take its part in the affairs of the community, the State, and the Nation; at the time when the stimulus of active participation in the national effort demanded by the War had made the profession proudly conscious of its ability to organize and direct big operations outside its customary field; at the time when Mr. Hoover himself had realized the ideal of engineering on a heroic scale; at that very time the steadily growing call across the whole of the United States for him to take the helm of the Republic has given engineers a chance to fulfill the dreams of civic usefulness, the ideals of public service, and the purpose of personal loyalty to the Chief, the president of the American Institute of Mining and Metallurgical Engineers and the supreme exponent of the responsibilities and privileges of the engineer in modern civilization.

The Premium on Gold

The dividends declared by the mines of the Rand for 1919 amounted to £6,287,205, as compared with £5,330,966 in 1918. We do not give equivalents in dollars, because the fluctuation of exchange would render it futile. The 'Financial Times', of London, says, with a chuckle, that "the actual dividends come within about £400,000 of the estimated working profits of £6,775,000". This is an acknowledgment of the fact that normally the official 'working profits' of the various mines and of the district as a whole are fictitious, in that they fail to allow for a number of essential expenditures. Usually they are wrong by 35 to 40%. For example, in 1915 the total 'working profit' was £11,931,062, whereas the dividends amounted only to £8,205,199. The approach to within 6½% of accuracy is due to the fortuitous help of the premium on gold during the last five months of 1919. This served to offset the statistical discrepancies caused by the customary failure to recognize the incidence of the excess-profits tax, the war levy, the Phthisis Act assess-

ments, and incidental expenses of various kinds. The premium on gold was about 20% during the last quarter of the year; it was enough to save some companies from collapse and to double the earnings of others. In the case of the Rand Mines Ltd., a large consolidation of holdings, the premium in November amounted to more than the monthly 'profit'. This pleasing phase of South African mining has moved our friend Mr. H. S. Denny to write an article on the subject for the 'Financial Times'. He shows that the 16 companies that were running at a loss during the last quarter of 1919 would have earned a profit if gold had fetched 105 shillings. Since then it has been quoted at 127s. 4d. per ounce, a premium of over 50%. In 1912 when the cost was 18½s. per ton, as against 23½s. now, the Rand made £1,050,000 per month. Even with gold at 110 shillings, the profit of the mines of the Rand is increased 2½ times, making it £1,345,250 per month. With gold at 130 shillings, the profit would run to an additional £8,500,000 per annum, that is, 20s. per ounce on a production of 8,500,000 ounces of gold. Of course, the excess-profits tax cuts into this surplus severely, and, doubtless, both the Government of South Africa and the labor-unions will exact a share of the unexpected prosperity; all of it will not be left to the mining companies, although, for ourselves, we would like to see some of it go to the shareholders on whom the 'insiders' have been unloading their stock for years past. The general result is a remarkable revival of the Rand mining industry, an actual gain in dividends that has given the shares of the productive companies an entirely new status, and the introduction of a fresh gambling element of the most attractive character. Ordinarily the price of gold is regarded as fixed; in its stability it is considered superior to the vagaries of the base-metal market, or even of silver; yet within six months it has fluctuated by 50%. This is an entirely new phase of the gold-mining industry and renders it speculative to a degree and in a manner wholly undreamt by those engaged in it or by the onlooking economist.

As may be imagined, the mining companies operating in the Kolar district of India, which produced 461,000 ounces of gold last year, have been looking jealously at the good fortune of those in the Transvaal. During the early part of the War the Indian companies deposited their output of gold at the Bombay mint for sale to the Bank of England at the pre-war price. Later the Government of India allowed them to retain an amount of gold equal to their operating expenses. After May 1919 the Bank of England and the Government of India arranged for half of the Kolar gold to be sold in India for rupees, which were worth 1s. 7d. at that date. Since then the rupee has risen to 3s. in sterling exchange, so that the companies have been saved a heavy loss. Now the Indian companies have been given permission to sell all their gold in London, where a large premium is obtainable; but this is not so advantageous as it seems at first sight; their position is different from that of the South African companies because rupee exchange interposes. The South African operator sells gold and buys labor in shillings;

the Anglo-Indian sells in shillings, but buys in rupees. South Africa is a region so undeveloped industrially, apart from gold mining, that it cannot absorb its own output of the standard metal, whereas India is an ancient and thickly populated country, of greatly diversified industrial activities, that can absorb not only all the gold of domestic origin but much more, and can pay for it at a price considerably higher than the European market. South African currency is based on the pound sterling, whereas exchange with India at this time works adversely to Great Britain when exports are made from London to Bombay. It is delightful for the South African operator to take his gold to London and arrange for the proceeds to be credited in pounds by cable to his account at Johannesburg, whereas it is decidedly unpleasant for the Indian operator to bring his gold to London and to pay for his expenses at the mine by a remittance in rupees at a time when the rate of exchange is greatly against him.

These are some of the anomalies of exchange as they affect the miner. It is conceivable that a person with large investments in South African mines might find it advisable to live in England, so as to avoid the loss of exchange and the double income-tax. Other contingencies, humorous to those not affected by them, will suggest themselves. Meanwhile the American gold miner is waiting his turn, for it seems certain that here also gold must appreciate in due course, without special legislation for the purpose. Statements have been made, we understand, that the smelters in this country are paying \$20 for the gold in custom ores and obtaining \$30 for it themselves; also that the Japanese are buying large amounts of gold here for shipment to Nippon. Both these statements are untrue. The smelters receive \$20.67 for their gold from the Mint as heretofore and anybody can buy gold at that price from the Mint, by arrangement with the Federal Reserve bank or the U. S. Sub-Treasury, and use or ship it, at will, without license. At the present time this country is losing gold, to the Orient and South America, especially Argentina, and the suggestion has been made that an embargo be placed on export, as during the War, in order to check this drain, but if it goes for legitimate payments it would be unwise to stop it. Some of it goes to jewelers and manufacturers in Sweden, Switzerland, and other European countries. We have no law against the melting of coin; if gold went to the premium now paid in London, there would be great losses of coinage. In England it is illegal to deface or destroy coins; a number of arrests have been made recently on account of violations of the law. Obviously the gold standard is undergoing a severe trial, rendered peculiarly confusing by the disparity of industrial conditions in Europe and America. Some countries have lost all their gold and in others the last ounce is earmarked for the payment of indemnities. It has even been suggested that an international currency be established. These are matters of grave concern and more than parochial importance. It is to be hoped that an international conference will be called shortly and that the members of it will prove wiser than the gentlemen who lately assembled at Paris.

Thawing Frozen Gravel With Cold Water

By WALTER S. WEEKS

This article deals with experiments in thawing frozen gravel at Nome. These experiments led to the discovery that surface water could accomplish the thawing effectively without the addition of artificial heat.

The experiments were made by John H. Miles, now at Trinity Center, California. Mr. Miles has written a description of his work. He has asked me to prepare this for publication and to discuss it. The following is Mr. Miles's description of the experiments.

"In 1916 I was engaged by the Alaska Mines Corporation, of New York, to take charge of their dredging operations at Nome, Alaska. Their holdings consisted of a large acreage on the famous Third Beach, the greater part of which was permanently frozen, and of greater depth than had been thawed by the saturated-steam method used throughout the North. While ground from 10 to 25 ft. deep can be thawed by this method for about 24 cents per cubic yard, ground ranging from 40 to 80 ft. deep is almost impossible to thaw at a price that will leave enough margin of profit to pay the expense of dredging. I concluded therefore that it was necessary to discover a new method of thawing with this object in mind.

"I made the trip from 'the outside' to Nome over the long white trail, arriving there on April 16, 1917—32 days after leaving Chitina, which is the point where the dog-trail begins. I commenced my experiments in thawing immediately. Having had considerable experience with saturated-steam thawing, I was of the opinion that superheated steam at about 1000°F. would be the means of thawing at a reasonable cost. My belief was that concentrated heat introduced into the ground at bedrock would travel parallel with the bedrock and up, but I soon found that this was not the case, as the heat came to the surface immediately, and formed a pool of water so hot that one could not hold his hand in it. I could see that I was on the wrong track, and with fuel-oil at 8c. per gallon the cost of thawing would be prohibitive.

"I chose for my experiments ground that would offer the greatest resistance to thawing, the character of the formation having been ascertained by churn-drill holes. The formation consisted of tundra, muck, quicksand, clay, and fine gravel. This is a combination that is very hard to thaw with steam, owing to its ice content and the compact nature of the material. The clay content bakes around the steam-point, forming an insulation that prevents the heat from radiating from the steam-pipe, and forms collars in the thaw-holes sometimes not larger than four inches in diameter.

"After selecting a suitable locality, I assembled my equipment, which consisted of a 12-hp. boiler and a superheater, made of several coils of 2-in. pipe with brick

and sheet-iron housing. My first experiment was with superheated steam. I used three points of $\frac{3}{4}$ -in. double extra-heavy pipe drawn down to $\frac{1}{8}$ -in. opening at one end. Two of the points were lowered into 6-in. churn-drill holes, the third was put down in the following manner: A 1-in. double extra-heavy pipe drawn down to $\frac{1}{4}$ -in. opening at one end was used, a clamp was placed around the pipe, and a weight having a hole in the centre was slipped over the pipe and attached to the walking-beam of a Keystone drill, which raised and dropped the weight, striking the clamp, and forcing the pipe. The pipe was rotated slightly at each blow by use of a Stillson wrench. Warm water at 20-ft. head was forced through the pipe, thawing and softening the ground at the point. In this manner the pipe was driven down 42 ft. in four hours and ten minutes.

"In the following season I developed a combination rotary-percussion drill, consisting of a 2-in. pipe with a serrated steel shoe, using cold water at 80 lb. pressure flowing through a pipe. The pipe made 20 revolutions per minute, and an 80-lb. weight, which dropped 60 times per minute, helped to force it down. With this machine I was able to sink the 2-in. pipe 40 ft. in one hour and twenty minutes. The pipe used in this machine is left in the ground and used as a thaw-pipe, the high-pressure water being replaced with low-pressure water at whatever head is available. This machine proved satisfactory for the soft formation. In like formations of shallow depth it is not necessary to force the pipe down by mechanical means; the pipe will sink of its own weight if rotated slightly by hand. I do not know what the results would be in a heavier formation containing large boulders.

"The results of the superheated-steam thawing were most unsatisfactory. After steaming for a few hours, the ground around the pipe began to sink, forming a lake of hot water, and the longer we thawed the hotter the water became. It became evident that with so much heat coming to the surface, very little thawing was taking place on bedrock. The nature of the ground was such that when thawed it was possible to probe with an iron bar to a depth of about 25 ft. By using this bar, I ascertained that the thawing in these holes was being done in the form of an inverted cone, as was subsequently proved when these thaws were dug out.

"Next I put in three saturated-steam thaws, using ordinary steam-points, but instead of driving with hammers, as is the common practice on shallower ground, I dropped the pipes into holes previously drilled by a Keystone machine. These tests showed very similar to superheated-steam tests, with the exception of thawing an in-

verted cone slightly smaller on top and extending to a greater depth.

"Then I tried hot water, using three holes, having heard of experiments conducted at Dawson with good results. A 1-in. double extra-heavy pipe with $\frac{5}{8}$ -in. outlet was used. Hot water drawn from the blow-off cock of a boiler was circulated through the pipe at an average temperature of 105°. By probing with an iron bar, I was able to determine that this method was far more efficient than the previous steam-tests from the fact of the walls of the hole being nearly parallel. But, as in the steam-tests, we were losing heat-units because the water failed to deliver its heat in the ground, but carried it to the surface, where it was wasted. This led me to think that thawing was a slow process, and that it was not a concentrated heat that was necessary, but a uniform circulation of water with just a few heat-units to give up. It then occurred to me to try surface water, the temperature at that time being 52°, and the temperature of the ground 28°F. Not having ditch-pressure available, I used a steam-pump with a 2-in. suction and $\frac{1}{2}$ -in. discharge. This pump delivered 20 gallons per minute at an average pressure equal to a 40-ft. head. The pump was connected to a 2-in. pipe, which was dropped into a 6-in. Keystone drill-hole.

"No results were apparent for 24 hours, when the 'muck' began to slough from the sides of the hole and retarded the circulation of water in the hole. From that time on one could see the progress of thawing. In 36 hours an 8-ft. area was thawed, and upon probing with an iron rod we found that the walls of the thaw were vertical, not the shape of an inverted cone as in the steam thaws. This was very gratifying. We watched the progress of thawing with increased interest. At the end of the eighth day, we decided to stop thawing on this hole and start another for a check, owing to the lateness of the season. The water entering the ground had a temperature of 52°; at the end of 24 hours the outgoing water was at 50°; at the end of 48 hours, 48°; at the end of 72 hours, 45°; at the end of 86 hours, 40°; at the end of 192 hours, 36°. To obtain maximum efficiency the amount of water entering the thaw-pipe should be governed by the temperature of the outgoing water. Just enough water should be used to keep the temperature of the outgoing water a little above freezing.

"In watching a cold-water thaw in operation, one sees the water boiling up around the outer edge of the hole, not in the centre. My theory of the operation is that the ground in thawing forms a porous streak between the frozen and thawed area, and the water finds less resistance in this channel than in the thawed area. Consequently, it takes this course and draws the frost with it, forming an ever-increasing area.

"The time consumed in these experiments, which included three superheated-steam thaws, three saturated-steam thaws, two hot-water, and two cold-water thaws, was from the 20th of April to the 25th of October, when the weather became too cold for further experiments. I had a good idea of the amount thawed and the shape of

each thaw from being able to use the long iron rod to prod through the loose thawed material, but I wanted an exact cross-section of each thaw. On December 1, when the surface water had frozen so that it was possible to sink shafts without the necessity of pumping, I let contracts to parties to sink shafts over the thawed test-holes in order to ascertain the exact amount of material thawed and the shape of each hole. This work was finished on December 20, 1917.

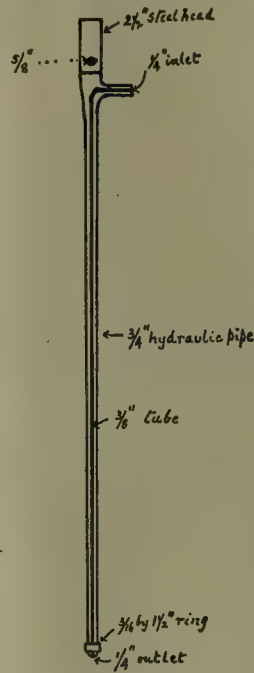
"The results of these experiments will be found in the accompanying chart. See Fig. 1. In my opinion the cold-water thaw was most advantageous because, first, it thaws a larger area on bedrock, and into bedrock itself for a considerable distance, thereby making it possible

for dredges to clean the bedrock without encountering the frozen pinnacles and frozen spots, which are invariably left by the present method of steam-thawing. I know of one dredge in the Nome district that lost its entire season's work by encountering these frozen pinnacles on bedrock when trying to dredge ground that had been supposedly thoroughly thawed by steam.

"Secondly, the heat units needed to thaw are supplied by nature at no expense to the operator, consequently ground in the outlying districts, where it has been impossible to procure fuel for steam-thawing, can now be thawed at no greater expense than ground near a fuel supply, thus opening for the prospector and operator a large area of the frozen North.

"Thirdly, the actual cost of thawing in ground such as I chose for my experiments, or ground much deeper, will be less than one cent per cubic yard, while the deep ground will necessitate some mechanical means, such as I have briefly described, to insert thaw-pipes. The shallower ground will not need any mechanical means to insert pipe, but will necessitate moving pipes more frequently, which will offset the cost of the machine, and will, I think, cost about the same, or possibly a little more per yard.

"In the spring of 1918 I had occasion to thaw a block of ground 130 ft. long by 80 ft. wide, by 11 ft. deep, composed of pure beach sand. I was interested to see what would be the difference in time between steam and cold-water thaws in actual operation, so I rigged up a battery of 12 points, using steam from a 20-hp. boiler. The men employed were experienced in steam-thawing, working two 12-hour shifts. At the end of the third day we had an area 20 ft. square partly thawed. I mean the area



A STEAM-POINT

was thawed on the surface, but by prodding down with a bar one could feel lumps of frozen ground. We stopped steam-thawing, put in a 4-in. centrifugal pump, from which we brought 12 one-inch openings. To each opening we attached a 12-ft. length of 1-in. garden hose, and

pipe would be about 6 inches in diameter. The pipe was left in the hole 30 minutes longer. The hole would then be about 36 inches in diameter. The pipe would then be drawn and started in a new hole. It was found best to move the pipe after about 45 minutes, as the water seem-

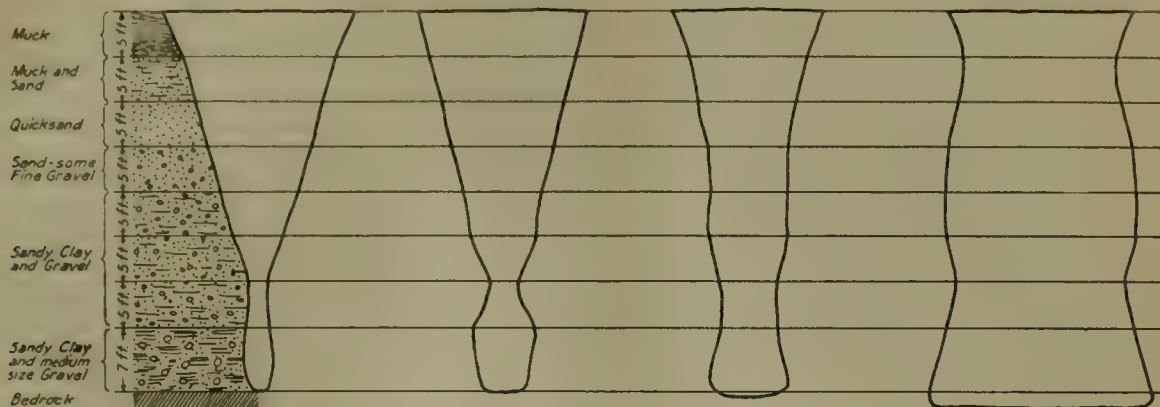


FIG. 1

Super-Heated Steam Thaw
 156 hours steaming.
 1755 gal. oil used.
 160°C. steam at boiler.
 310°C. steam at points.
 60°C. water at surface.
 109 cu. yd. thawed.

Saturated-Steam Thaw
 98 hours steaming.
 882 gal. oil used.
 160°C. steam at boiler.
 120°C. steam at points.
 40°C. water at surface.
 83 cu. yd. thawed.

Warm-Water Thaw
 67 hours thawing.
 405 gal. oil used.
 44 ft. depth of ground.
 105°F. water at points.
 70°F. water at surface.
 81 cu. yd. thawed.

Cold-Water Thaw
 192 hours thawing.
 20 gal. water per min.
 40-ft. pressure.
 52°F. water entering.
 511 cu. yd. thawed.
 1.9c. cost per yard.
 \$5.75 cost of drilling hole to install thaw-pipe.
 \$4.20 cost of connecting and disconnecting pipe.
 No charges made for use of water.

Note: 8c. per gal. cost of oil. 70c. per hour cost of labor when thawing. \$11.50 per shift for labor when inserting points.



STEAM-POINTS IN PLACE IN A LAYER OF GOLD-BEARING SEDIMENT, COVERED BY FROZEN GRAVEL, WHEN THAWING IN THE USUAL WAY

on the end of each hose was attached a piece of common 1-in. pipe 12 ft. long. There was hardly any pressure at the end of the pipe, probably one pound, not more. The pipes were held up by hand until they had sunk about one foot into the sand, then they were left alone to sink into the sand as they thawed. In 12 minutes the pipe would sink through 11 ft. of sand. The hole around the

ed to start circulating under the 11-ft. cap of frozen sand and the thawing action on sides of holes was retarded. With these 12 one-inch pipes two men thawed the remainder of the area, and also re-thawed the ground partly thawed by steam in four days and nights. The whole area was thoroughly thawed."

In brief, thaws were 'put in' with superheated steam,

saturated steam, hot water, and cold water. In each case the thawing medium was introduced at the bottom of a churn-drill hole. When the surface water was frozen, shafts were sunk on the drill-holes and the volume of the thaw determined. The chart (Fig. 1) shows the cross-section of a thaw of each type.

Let us attack the subject from the point of view of the heat-units involved.

The gravel, at the place where the experiments were made, weighed, as nearly as I have been able to determine, 3000 lb. per cubic yard, and each cubic yard contained about 300 lb. of ice. Nearly all the heat used in thawing frozen ground is consumed in melting such ice as may be there, so, for such an approximate calculation as this, we may neglect the small amount of heat used in raising the temperature of the solid material. In the steam and hot-water thaws our only information about the available heat is the amount of oil used. I think it will be reasonable to assume a 50% boiler efficiency and so debit the thawing medium with one-half the heat-units in the oil used. Since we are guessing at the boiler efficiency, it would be too great a refinement to consider the heat in the feed-water.

Let us consider the experiments in the order in which they appear on the chart.

No. 1—Superheated Steam

Hours	156
Gallons of oil	1755
Cubic yards thawed	109

To determine what proportion of the heat supplied in the steam was used in thawing, I shall use hourly quantities in order that the figures may be less unwieldy.

Gallons of oil per hour	11.25
Cubic yards thawed per hour	0.7
B.T.U. per gallon of oil	140,000

If we assume a boiler efficiency of 50%, we shall have available 70,000 B.T.U. for every gallon of oil used.

B.T.U. necessary to melt one pound of ice	144
B.T.U. supplied per hour	$11.25 \times 70,000 = 787,500$
B.T.U. necessary to melt ice per hour	$0.7 \times 300 \times 144 = 30,240$
Efficiency of absorption	$\frac{30,240}{787,500} \times 100\% = 3.8\%$

No. 2—Saturated Steam

Hours	98
Gallons of oil	882
Cubic yards thawed	83
Gallons of oil per hour	9
Cubic yards thawed per hour	0.85
B.T.U. supplied per hour	$9 \times 70,000 = 630,000$
B.T.U. necessary to melt ice	$0.85 \times 300 \times 144 = 36,720$
Efficiency of absorption	$\frac{36,720}{630,000} \times 100\% = 5.8\%$

No. 3—Hot Water

Hours	67
Gallons of oil	405
Cubic yards thawed	81
Gallons of oil per hour	6.04
Cubic yards thawed per hour	1.21
B.T.U. supplied per hour	$6.04 \times 70,000 = 422,800$
B.T.U. necessary to melt ice	$1.21 \times 300 \times 144 = 52,272$
Efficiency of absorption	$\frac{52,272}{422,800} \times 100\% = 12.3\%$

No. 4—Cold Water

Hours	192
Water per minute, gallons	20
Cubic yards thawed	511

In this case we are able to determine directly the available heat-units.

Water per hour, gallons	1200
Cubic yards thawed per hour	2.66
Temperature of water introduced	52°F.
Heat-units per pound of water theoretically available	$52 - 32 = 20$

Heat-units given up per gallon	$20 \times 8.35 = 167$
Total heat available	$1200 \times 167 = 200,400 \text{ B.T.U.}$
Heat necessary to melt the ice	$2.66 \times 300 \times 144 = 114,912 \text{ B.T.U.}$
Efficiency of absorption	$\frac{114,912}{200,400} \times 100\% = 57.4\%$

To summarize: of the total heat applied in each case the following proportion was actually used in doing the useful work of thawing:

Superheated steam	4%	Hot water	12%
Saturated steam	6%	Cold water	57%

A study of the steam thaw shows that the clay was penetrated only to a slight extent. The description would indicate that most of the heat in the steam was expended in keeping hot a comparatively quiet pool of water. There could have been very little circulation of the hot water because a 12-hp. boiler will evaporate only about one gallon of water per minute.

The hot-water thaw shows uniform thawing, but low efficiency. The efficiency of the heat absorption increases as the area of frozen ground in contact with the thawing medium increases. This is clearly shown in the temperatures of the outgoing water in the cold-water thaw. If the hot-water thaw had been continued as long as the cold-water then the efficiency doubtless would have been much greater.

The cold water apparently accomplishes all that is desired and at slight expense. Clay is no impediment. A vigorous circulation must be maintained so that the cooled water is quickly removed and replaced by more, which has a few heat-units to give up.

In the 'Engineering and Mining Journal' of March 22, 1919, there is a short description of the results obtained on Candle creek by the cold-water method. I understand that other tests have been made in Alaska during the past season. I am sure that any discussion or information on the subject will be welcome to the engineering profession and to mine-operators in the North.

A PROCESS of extracting aluminum from labradorite has recently been developed in Norway. The process involves the solution of labradorite in dilute nitric acid made locally, leaving the impurities as a residue; evaporation and heating to a point at which the aluminum nitrate alone is decomposed; and the dissolving of the calcium and sodium nitrates in water, leaving pure aluminum oxide. Labradorite, as ordinarily found in this country, is not sufficiently soluble in nitric acid to make this process seem feasible on a commercial basis; but it is possible that the Norwegian material is not a true labradorite and is much more soluble. Pure labradorite contains about 30% alumina or 16% metallic aluminum.—U. S. Bureau of Mines.

For the first eleven months of 1919 the value of silver exported from the United States to India amounted to \$109,180,718 while China's share (including Hongkong) was \$60,125,178. For the first seven months of 1919 the proportion was \$108,273,177 to India and \$17,458,606 to China and Hongkong. This gives an idea of how the Chinese demand has grown.

The Distillation of Shale-Oil

By JAMES A. BISHOP

The first essential in operating chemically upon any substance is to familiarize ourselves with its nature and compounds. Until this work is accomplished no operator can define concisely the problem before him, and not knowing his problem, he can develop only a vague idea of the chemical and mechanical requirements of the machine through which he should operate. The subject of shale-oil distillation naturally directs our attention first to the origin of the substance commonly known as kerogen, which occurs in some shale formations, and from which oils that are similar to crude petroleum may be secured. As many theories for the deposition of kerogen are being advanced, this phase of our subject may profitably be deferred until an accumulation of data will direct our efforts more accurately. A subject of greater importance is the nature and qualities of those compounds which may be educted from kerogen, or, stating it more scientifically, those commercial compounds into which worthless kerogen may be resolved.

CONSTRUCTIVE V. DESTRUCTIVE DISTILLATION

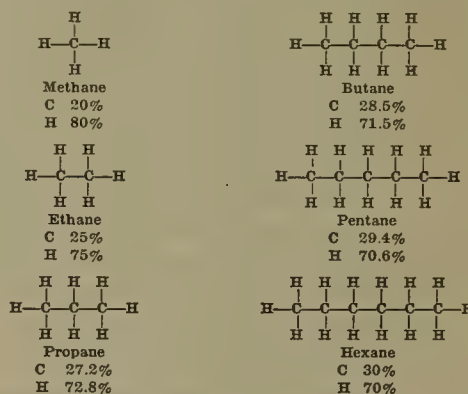
Seemingly in defiance of the chemical engineer, in the formation of kerogen, Nature has utilized that series of hydrocarbons deriving the name paraffin, meaning 'without affinity', from this inert quality. Those chemical reagents which do act upon the paraffin compounds are too expensive to justify their use commercially in any form of digesting process. We are thus driven to the use of heat, and since the compounds derived from kerogen are all combustible and some of them explosive, the charge must be treated in an air-tight oven and the heat applied externally. This form of discharging the volatile from the solid or non-volatile is called distillation. The process falls naturally under two classes: (1) Some substances are composed of simpler compounds which vaporize at different temperatures, and hence can be separated without chemical change to the various units. (2) The constituent compounds of other substances seem to be so interrelated chemically that the difficulty of their isolation causes the elements to resolve themselves into new compounds, usually of simpler molecular formulae. This is especially true when acted upon by excessively high temperatures. The name 'destructive distillation' is applied to the formation of these new compounds. The term is unfortunately chosen and is often misleading, especially to the layman in the art of distilling, who, since he is engaged in destructive distillation, believes that the most complete destruction of his original compound will ensure better results in the end. We know that the organic matter composing kerogen contains a given amount of carbon and hydrogen. We also know that by proper manipulation we can cause combinations of those two

elements in such proportion as will produce compounds of commercial value. The real essence of our work is 'constructive' rather than 'destructive'. Even though our results are secured through distillation, we maintain that we are manufacturing commercial products from Nature's crude materials, and that our process is based upon constructive distillation.

CHEMICAL AND PHYSICAL PROPERTIES

Through many analyses of the organic matter deposited in shale we know that it is composed principally of that form of hydrocarbons known as the saturated, or paraffin, series. Normal paraffin hydrocarbons are composed of but two elements, carbon and hydrogen, combined under one constant ratio, such that the hydrogen atoms equal twice the carbon atoms plus two. Thus, if 'n' represents the carbon atoms in the compound, $2n + 2$ represents the hydrogen atoms, hence the symbol C_nH_{2n+2} may represent each and every compound of the series, ranging from CH_4 , methane gas, to $C_{60}H_{122}$, hexacontane.

For the sake of comparison let us examine the first half dozen symbols showing the straight-line linkage of the normal paraffin series of the hydrocarbon compounds.



The first and simplest of the carbon compounds is methane gas, a product of the mild force of decay, where the carbon atoms are easily disengaged and we find an abundance of hydrogen to satisfy, or saturate, their four valence bonds. The gradual diminution of the hydrogen supply forces Nature to economize in its use, while increasing the heat for the separation of the carbon atoms for use in the succeeding compounds. While hydrogen decreases from 80 to 70%, carbon increases from 20 to 30% in the first six members of the series. The physical conditions of the series range from the light methane gas to light liquids, to heavier liquids, to fuel and lubricating oils, and finally to solids as determined by the predominating element hydrogen or carbon.

The hydrocarbons form a large group of organic substances, and may be divided into two main classes, saturated and unsaturated. The saturated are so called because the carbon atoms composing the molecule are connected by single bonds. So long as only one bond exists between the carbon atoms, no other atoms, as hydrogen, chlorine, etc., can be easily added to the molecule. It is, therefore, said to be saturated, and having slight affinity for other atoms, the terms saturated and paraffins are used interchangeably.

When carbon atoms within the molecule are joined by two or more bonds, one of those bonds may be easily broken and the carbon bond may be used to engage an atom of a different element. Such hydrocarbons are said to be unsaturated and belong to a different series. The double linkage of the carbon to carbon atoms does not produce a firmer union, as we might suppose, but the breaking of the chain at the double linkage seems to indicate a divided attraction of carbon to carbon at that point.

Although we maintain that a skilful operator may educt and refine his oils into either series *ad libitum*, the paraffins at present are demanded by the public. We will therefore discuss those problems which constitute a part of the paraffin-distillation process.

The lack of uniformity in the hydrocarbon contents of shale indicates an incipient decomposition after the deposits were made. The residue is clearly an asphaltic hydrocarbon in which the element, carbon, predominates. The first appeal, therefore, to the operator is the conservation of his stock in hand of hydrogen. The waste of that element in the first-grade distillates means a deficiency of hydrogen in the third grade and the solidifying of carbon into worthless coke at the expense of the vaselines, paraffins, and tars. The charge of shale will be brought to a distilling temperature very gradually if that will-o'-the-wisp, hydrogen, is to be retained for the liberation of enough carbon to convert it into light oils, rather than fixed gases. Owing to the small content of carbon in those oils distilling under 150°C. their specific gravity is light, the degree of viscosity is low, and their vapors are fairly elastic. For these reasons the distillates of the first grade will transport themselves from the heated regions of the distil to those of safety, if opportunity to do so is given them. The instant removal of the second and third-grade distillates is of gravest importance and merits our most careful consideration.

THREE GRADES OF DISTILLATES

There seem to be no valid reasons which justify the construction of the distil and its condenser for fractioning the distillates into more than three grades, unless the condenser has a cooling capacity which will pass the so-called fixed gases through a freezing temperature. In that case a fourth grade might be profitably added for the liquefaction of rhigolene. The three grades are: (1) those whose boiling-points range from zero to 150°C. = 302°F.; (2) those boiling between 150°C. and 300°C. = 572°F.; (3) those boiling above 300°C.

The still must be regarded and operated as the most important factor of a shale-oil eduction plant. Any values escaping the still go with the spent shale into the discard, and all oils improperly treated are either lost or so reduced in value that their reclamation in the refinery is impossible. However, the still and its condenser should be subservient to the refinery. The oils should be educted and liquefied in such a manner as will assist the refinery in satisfying the demands of a critical public. The three sections of the still producing the three grades above named should be well defined, at least in the mind of the operator, and so constructed as will make changes of manipulation possible. The manager of the still and condenser should reasonably understand the fractioning which his three grades of still products will undergo in the refinery.

A liquid exposed to the air evaporates, or passes into a state of vapor, but under similar conditions different liquids evaporate at different rates. If heat be applied the rate of evaporation increases. As the molecules of the vapor accumulate over the surface of the liquid they exert a pressure against the atmosphere. This pressure is called 'vapor pressure'. When vapor pressure exceeds atmospheric pressure bubbles pass up through the liquid, which is then said to boil. At the boiling-point the liquid passes rapidly into a vaporous condition, and the ability of a liquid to vaporize, that is, its vapor pressure, determines its boiling-point. It is evident that the operator must know, from the temperature he applies, exactly what part of his charge he is vaporizing.

FRACTIONING THE THREE GRADES

The members composing the paraffin series run into the hundreds, and about sixty, ranging from methane gas, CH_4 , to hexacontane, $\text{C}_{60}\text{H}_{122}$, with many of their isomerides, have been separated. Shale distillates, however, when properly treated are all included in the first 35 members of the paraffins. The first four members, although usually considered gaseous, may be liquefied by cold and pressure. Thus methane, the lightest and simplest of the series liquefies at -164°C. and solidifies at 186°C. But such extreme temperatures prohibit the liquefaction of the first members for commercial purposes. They are, therefore, considered fixed gases. The next eleven members, including $\text{C}_{15}\text{H}_{32}$, vaseline, are liquids or semi-liquids, while all beyond are solids, with melting and boiling-points increasing as the molecular weights increase. The addition of each CH_2 raises the boiling-point of the resultant members.

Owing to the fact that kerogen was first deposited in bogs or lakes, the chemical action of decay no doubt liberated the light inflammable methane gas, CH_4 . We therefore find that kerogen supplies only limited quantities of that gas. The fourth member, butane, though strongly of a gaseous nature, may be condensed to a liquid at zero°C. This liquid is called cynogen, and as it boils at one degree above zero its preservation in a liquid state is somewhat difficult. It is sometimes used in refrigeration.

The first liquid to condense through ordinary means is the condensate of pentane, C_5H_{12} , and is called rhigolene. Since it boils at $18^\circ C. = 64.4^\circ F.$, it will escape the condenser, and remain with the so-called fixed gases, unless subjected to a freezing temperature. Rhigolene is used as a local anesthetic by the medical profession, and in some foreign countries for the production of a flame of standard luminosity.

As the temperature rises to $70^\circ C.$ the second liquid distillate vaporizes; after liquefaction this is known as benzine (not coal-tar benzol). From this fraction three oils may be derived: (1) gasoline, consisting principally of pentane and hexane; (2) motor-oil of commerce, consisting largely of heptane, C_7H_{16} ; (3) the heavy portions distilled below $150^\circ C.$ in their liquid state, which are called ligroin and are often used as polishing-oils. They consist principally of octane, C_8H_{18} , and nonane, C_9H_{20} .

The paraffin members having boiling-points between $150^\circ C.$ and $300^\circ C.$ are eight in number and terminate with heptadecane, $C_{17}H_{36}$. The last member supplies some of the low-melting vaselines. The oils derived from the second-grade distillates are known as 'kerosene', or illuminating oils, in America, and as paraffin, or lamp-oil, in Great Britain. The heavy portions of this fraction supply lubricating oils.

After the removal of all distillates which are educted from shale by a temperature of $300^\circ C.$, there remains a residue which is sometimes used as fuel oil, but from which such valuable products as lubricating oil, paraffin, and tars may be fractioned. Owing to the high boiling-point of the third-grade distillates their fractioning demands scientific knowledge and skill. Thus when fractioned under vacuo there remains a substance, vaseline, of doubtful composition, ranging from hexadecane, $C_{16}H_{34}$ to eicosane, $C_{20}H_{42}$, together with some of the unsaturated hydrocarbons.

Even in this brief review of shale-oil distillation we cannot dismiss the subject without mention of two more important compounds. The heavy hydrocarbons ranging from $C_{24}H_{50}$, tetracosane, to $C_{35}H_{72}$, pentatriacontane, form the highly important commercial paraffin wax and tar. Because of the 10% to 30% of suspended carbon in tars they usually assume very dark colors. They contain small proportions of acid, and basic products, together with higher percentages of neutral compounds, which are modified by the temperatures and the style of the distil employed. A carefully managed distil will avoid the production of the benzenes, unless their market price should invite such production. The neutrals may be fractioned into many different products, but four especially have wide applications; namely, benzol, phenol, toluene, and naphthalene.

A few persons of limited experience are demanding a shale-oil retort so constructed that the distillates from shale be fractioned in the retort. The foregoing brief outline should convince the advocates of the combined operations that the distil is not a refinery, and cannot, except in a restricted way, perform the work of both. The extraction of the oil from shale is first in importance,

and entangling processes in connection with that of distillation should be avoided. The delivery of the different fractions requires a sectional distil, each section of which will demand special supervision. The fixed gases naturally constitute one of the fractions and instant isolation from the oils prevents any possible chemical combination therewith. Distil fractioning means the production of an excessive volume of gas. Fractioning may be accomplished in two ways: (1) by the injection of given temperatures for each product; (2) by the extraction of heat from its vapors, each product liquefies as the temperature falls below its boiling-point. The second operation may be performed in the condenser as the mixed vapors are discharged from the distil. But neither the distil nor the condenser can complete the fractioning in a manner that will satisfy the demands of the oil industry. All the fractions from the distil or its condenser must pass through a refinery equipped for the exacting work required. Why, then, attempt the impossible through the eduction plant, when unsatisfactory results are the only possible compensation for a reduced tonnage?

PARAFFINS, OLEFINES, AND BENZENES

The association of kerogen with shale strongly indicates sedimentary deposition in bogs or lakes. It seems, therefore, highly probable that kerogen has escaped the destructive influence of heat, except the mild temperature of organic decay, which was insufficient for the reduction of paraffins into olefines or benzenes. These conditions point strongly to the existence of paraffins only in shale deposits, and that the presence of either olefines or benzenes in the distillates suggest improper methods of distillation. This conclusion is supported by the fact that a careful review of the annual output of large European distils reveals no benzenes as direct distillates from shale.

THE CRACKING OF HEAVY OILS

Cracking processes are exclusively refining methods and have no place in a shale-oil distil. Any shale distil so constructed that the cracking of oil distillates cannot be avoided is fit only for the discard. Cracking is a decomposing method. It might be called a reduction descending process. The paraffin hydrocarbons, though inert to many reagents, are extremely sensitive to the influence of high temperatures, and high temperature distillation greatly increases the volatile constituents of the distillate. This principle was discovered in 1861 through the accidental over-heating of an oil-still. It was found that the contents of the still had been changed to lower homologues of the paraffin series, and in part to the olefine and benzene series. The process takes its name from the popping or cracking sound often heard in connection with the boiling of a dense heavy fluid. The name, cracking, gives no suggestion of the principles involved in the process. The cracking of the paraffin hydrocarbon $C_{15}H_{32}$ might give a lower paraffin $C_{10}H_{22}$ and the olefine C_5H_{10} , or it might give the paraffin C_7H_{16} and olefine C_8H_{18} . Let it be observed that the olefine contains only twice as

many hydrogen atoms as carbon while the paraffin contains twice as many hydrogen atoms + 2.

The sensitive nature of the paraffins when subjected to high temperatures is undoubtedly due to the constantly diminishing supply of hydrogen, and a greater supply of carbon atoms as the temperature rises. Let us assume that the portion remaining in the paraffin series had the advantage of position, less heat, or in contact with a greater number of hydrogen atoms. It simply discards a portion of its carbon, and gathers in a higher percentage of hydrogen. The outcast carbon cannot secure the proper number of hydrogen atoms to build up a higher paraffin compound, much less one of the lower members of the series, where a higher percentage of hydrogen is required. Nature is now burdened with a misfit number of carbon and hydrogen atoms, and there seems nothing to do but to bolt the paraffin series and place her refugees into the olefines, where one carbon is compelled to exist with only two hydrogen atoms. Or failing in this she is forced to knock at the door of the benzenes for admission, where one carbon must be content with one hydrogen. There remains only one more alternative if the proportions of carbon and hydrogen are not numerically correct, namely, a complete divorcement of the two stray elements, by which hydrogen is forced to travel alone as a gas, and carbon uniting with carbon solidifies into coke.

When compounds contain an excess of carbon, under high temperatures the diminishing supply of hydrogen fails to satisfy or saturate the released carbon atoms. The straight-line linkage of the paraffins no longer serves as the chemical yard-stick for determining the nature and composition of the hydrocarbons. Although carbon has a strong affinity for other elements it will, under high temperatures and a limited supply of other elements, unite with itself. Three bonds link carbon to carbon, leaving only one bond to be satisfied by some other element, as hydrogen, thus using equal numbers of carbon and hydrogen atoms in the new compound. The hydrogen content is reduced from 14 as in the paraffin, hexane, to six atoms in benzene, the model compound of the benzene or chain-linked series.

VISCOSITY RETARDS DISTILLATION

When heat is applied to the organic solids incorporated in shale, it at once becomes the opponent of two dormant forces, one chemical, the other physical. These forces are forms of attraction which act at insensible distances. The chemical force is called affinity, and acting between the atoms of different elements parcels them into groups, or molecules, according to the linkage of that series which the degree of heat renders permissible. The physical force, known as cohesion, acts between the molecules and determines the character of the substance as solid, liquid, or gaseous. If only sufficient heat is applied to convert the solids into liquids, the chemical force will, no doubt, arrange the atoms after the plan ordained by the paraffin series of hydrocarbons. But liquids are not susceptible of motion as vapors are and the process must be carried one step farther. The next step is a delicate one. We

wish now so to weaken the cohesion that the liquid becomes a vapor without disturbing the atomic arrangement within the paraffin molecule. In other words, we want the paraffin molecule in the vapor state to remain identical with the paraffin molecule in the liquid state with only a change in its cohesion. But cohesion is a force to be reckoned with since it varies from almost imperceptible attractions to enormous tensile strength. We are all familiar with the sledge-hammer blows required to drive a cold chisel through a bolt or bar of cold iron. The blacksmith weakens the cohesion by heating his iron to 1800°F. at which temperature he cuts his bar with ease, and the foundryman by injecting 2800°F. of heat drives the iron molecules so far apart that cohesion is neutralized and the iron lies as a noncohesive liquid in his ladle. In like manner, though in milder degree, we drive the paraffin molecules asunder by the injection of heat, but at the risk of destroying the chemism between the atoms and changing the structure of the molecule. In endeavoring to retain the internal structure of the molecules we fail to neutralize completely the cohesion between them. There remains, therefore, in small degree, a viscosity between the oil-vapor molecules which causes them to hang together and form an obstructing layer over the shale charge. Distilling under a partial vacuum has been suggested, but a vacuum has neither a pull nor a suction upon an inert vapor. Although we speak of the suction pump, the plunger of a pump has no lifting power until it gets under the substance to be pumped. As the plunger rises the expansion of air within the pump forces it to follow the plunger and keep the space filled. As the pressure within the pump decreases water rises, not from a pull or suction, but from the downward atmospheric pressure on the outside water surface. The water ascends in the pump for exactly the same reason that the light end of a scale beam rises. Whether the distillation is performed under vacuum or not, it is evident that the transportation of the oil-vapors is dependent upon their own expansion qualities, or that of some auxiliary vapor.

Crystallography is so exact a science that substances may often be recognized by the form and structure of their crystals. Had we the power of viewing the molecules which compose the crystals, we would doubtless find them just as methodically constructed as to size, form, and weight. Any aggregation of the molecules composing the inert vapor layer over the shale charge may be well represented by a box filled with marbles of exactly uniform size. The spaces between the marbles will show as great uniformity as the marbles themselves, but no space is of proper shape and size to admit one of the marbles. We may assume that vapor molecules liberated from the shale charge will bombard the under side of the vapor layer for a passage. They cannot enter the intermolecular spaces, because they are not of proper size or shape. They must either lift the vapor layer or violently disrupt the temporary arrangement of its molecules, either of which will require an excessive amount of heat, and result in cracking the vapors.

THE USE OF STEAM IN DISTILLATION

European operators discharge large volumes of steam into the shale charge on the theory that it assists in dissolving, distilling, and cushioning the paraffins. The term 'cushioning' seems to carry a doubtful meaning, and we think may be profitably exchanged for 'transporting'. We know that the expanding or carrying powers of vapors from different liquids is by no means uniform. A cubic inch of gasoline vaporized expands into 320 cu. in. of vapor of the same pressure as the gasoline. But a cubic inch of water vaporized expands into 1728 cu. in. of steam of equal pressure to the water. Thus the expansion of water vapor is more than five times that of gasoline vapor. Water evaporated in a vacuum quickly occupies the entire space of the vacuum. Although gasoline vapor will in time fill the entire vacuum cavity, its low expansion value compels a sluggish action. The vapors secured from liquids whose boiling-point is above 300°C. are even slower in their expansion than those of gasoline, and lie heavily upon the surface of the charge. To illustrate the difference in their volatility, place a drop of water and a drop of oil side by side on a piece of glass. The water quickly evaporates and disappears. The oil remains unchanged, perhaps for days, due to its viscosity, a quality not possessed by the water. As we might expect, this hanging clinging quality of oil raises its boiling-point far beyond that of water, and renders the separation of its molecules into a vapor state somewhat difficult. Since 100° of heat overcomes atmospheric pressure in boiling water, having very slight cohesion, we may safely conclude that the additional 200° required for boiling oil is used in neutralizing the cohesion of its molecules. Hence, any process that will assist in breaking the cohesion of oil-molecules lowers the boiling-point to just that extent. Two oils are said to be miscible when their molecular surfaces adhere to each other. If two such oils are mixed in a still charge a new opposition force to the boiling-point is added. Enough heat must be applied to overcome atmospheric pressure, the cohesion of like molecules and the adhesion of unlike molecules. The boiling-point will very naturally be raised. On the other hand, if two nonmiscible liquids, as water and oil, are distilled together, each will vaporize just as if the other were not present. There is no adhesion between the molecules of oil and water. The vapor molecules of one occupy the intermolecular spaces of the other. Each contributes to the vapor pressure upon their surface, and when their combined vapor pressures equal the atmospheric pressure, boiling or rapid evaporation takes place. The highly expansive water molecules push the oil molecules farther apart. This increase of space between the oil molecules weakens their cohesion and rarefies the vapor mass. Now rarefaction means less vapor pressure upon the shale surface. It is evident that any vapor pressure exerted by the water vapor (steam) relieves the oil vapors to that extent in counterbalancing atmospheric pressure, and lowers the boiling-point of the oil. It is the equivalent of distilling the oil in a partial vacuum, thereby lowering the vaporization point, and in

the same process, supplying a vehicle for the conveyance of the slightly mobile oil vapors. This law was discovered by Dalton and is one of the beacon lights of physical science. It is Nature's answer to the question: "Should steam be used as one of the factors in the distillation of oil from shale?"

THE DISTIL A CONTRIBUTION TO SUCCESS OR FAILURE

The requirements of the distil are many and very exacting, and on the merits of his distil the operator will travel toward success or failure. All compounds of commercial value must be extracted from the shale in the distil or go into the discard ash. The temperatures for the three grades of distillates must be uniformly maintained, and the shale charges transferred to the regional sections as required. Steam will contribute as one of the factors of the successful distil and be let into the charge at the most advantageous point. The successful distil will be capable of such a wide range of manipulation that it will be of small moment to the operator whether the charge is composed of dry paper shale or of the agglomerative variety. Efficiency and tonnage capacity must characterize each step in the process. The distil of intermittent action, with its accompanying loss of time, heat, and labor in charging and discharging, cannot keep the required commercial pace. It must be of continuous action in the charge and discharge of shale.

THE FOLLOWING ORES are mined in Finland, or prospecting work concerning them is carried on: Copper, pyrite, magnetite, galena, and molybdenite. The principal copper mines are at Outokumpu, on Lake Ladoga, and at Orijärvi, west of Helsingfors. There are iron mines on Lake Ladoga, and at Jussaro, on the coast west of Helsingfors. The Director of the Geological Survey of Finland states that there are extensive deposits of iron ore in Lapland. Finland's iron ore is not of the best quality. Pyrite is mined in Sotkamo, and at Otravaara. The molybdenite prospecting pit lies at Matasvaara, south-east of Nurmes. In the 'seventies gold was discovered in the north of Finland in the bed of the Ivaljoki, which empties into the Arctic. Gold washing since then has taken place regularly, but with inconsiderable results. Only small quantities of ore were produced in 1918 because of the War and the high cost of labor. At Outokumpu, 12,000 tons of copper ore was mined; at Pitkaranta, 3000 tons of magnetite; at Tipasjärvi, 800 tons of iron pyrite; and at Otravaara, 1000 tons of iron pyrite. Prospects are good for mining copper at Outokumpu, where there is a large orebody containing 6,000,000 to 8,000,000 tons of ore with 4% of copper and 27% of sulphur.

GRAPHITE is the most important of the developed mineral resources of Ceylon, the mines having a normal capacity of approximately 30,000 tons per year. Other products mined are gems, salt, mica, and monazite sand, the two last being of minor importance. No mineral oils have been found, nor have any geological surveys discovered petroleum deposits on the island.

Neutralizing Mine-Waters on the Rand

By F. WARTENWEILER and E. H. CROGHAN

*The problem of neutralizing mine-water on the Rand has received a certain amount of attention, and has, at a number of mines, been dealt with in an efficient manner. It should be noted that the metallurgist is interested because most of the replenishing or make-up water for the mill circuit, particularly during the dry season, is water pumped from underground. He is also called upon in many cases to treat the precipitated sludge for gold recovery. Neutralization of mine-water and the study of the sludge formed thereby are so closely related that they must logically be considered together.

The formation of acid in the mine-waters, due to oxidation of the pyrite constituent of the banket and surrounding country rock, is well known and need not be especially enlarged upon here. Aside from organic compounds, arising from decomposition of timber and occasional pollution by underground sewage, the following constituents are generally contained in mine-water: free sulphuric acid, soluble silica, ferric sulphate, ferrous sulphate, aluminum sulphate, and the sulphates of calcium, magnesium, and alkalis, together with chlorides.

In the treatment of the acid mine-water the following four objects may be held in view:

(1) The efficient and economic neutralization of the free acid (sulphuric) and of the acid ferric sulphate, to prevent pipe and pump corrosion.

(2) The settlement underground of the solids suspended in the water so as to deliver reasonably clear water to the pumps in order to avoid excessive abrasion and choking of pipe-lines.

(3) The complete neutralization of free acid, precipitation of ferric and ferrous sulphate and sulphate of magnesium, and settlement of the precipitated salts to render the water suitable for use in the reduction works.

(4) Neutralization of the free acid accompanied by settlement or filtration, to render the water suitable for use and re-use in underground spraying and washing in accordance with government regulations.

The following example illustrates the difference from a metallurgical standpoint of the effect of inefficient and efficient mine-water treatment:

A rather objectionable, unsettled, and partly neutralized water delivered by the underground pumps for reduction works purposes on a Central Rand mine gave the following incomplete analysis:

(a) Free acid (in terms of sulphuric acid).....	0.008%
(b) Total suspended matter.....	0.357%
(c) Ferrous oxide in solution.....	0.005%
(d) Ferrous oxide contained in (b) 5.70%, which is equivalent to 0.020% on the original water.	

*Abstracted from a paper in the Journal of the South African Institution of Engineers.

This partly neutralized water with its suspended matter, on contact with cyanide solution, resulted in a loss of 2.58 lb. KCN per ton of water. On rendering alkaline to phenolphthalein and filtering, the cyanide consumption was nil.

The neutralizing reagents in current use on the local mines are carbonate of soda (Na_2CO_3), unslaked lime (CaO), slaked lime [$\text{Ca}(\text{OH})_2$], and pulverulent carbonate of lime (CaCO_3).

SODA. The soda used until recently has been in the form of crude soda obtained from a natural deposit in the Pretoria district, containing 60% of Na_2CO_3 , the balance being chiefly water of crystallization and detritus of the deposit. It effects the neutralization of the free acid, the precipitation of the iron salts ultimately as hydrated oxides, and sulphate of lime as carbonate, but leaves the cyanide hydrolizer, magnesium sulphate, incompletely precipitated under working conditions, that is, in the cold. In the past crude soda has generally been added only in sufficient quantity to obtain the first object, namely, to prevent pipe and pump corrosion. Incrustations in the pump columns have not been formed to a serious extent.

CALCIUM CARBONATE. This reagent is a natural pulverulent form of carbonate of lime, found in extensive deposits in several parts of the Transvaal. Examination of a representative sample shows a CaCO_3 content of 90%, grading 91% passing a 200-linear mesh screen.

According to small-scale tests, the first step, (1), cannot be carried out with this carbonate of lime to quite the same degree of neutralization without the use of a large excess of reagent and a contact extending over considerable time. With a 50% excess over theoretical requirement, 89.5% of the free acid and ferric sulphate was neutralized in 15 minutes. More time should evidently be given to render the water neutral to methyl orange. If it is safe to pump water slightly acid, then less CaCO_3 may be used. With a 10% excess, 82% of the free acid and ferric sulphate was neutralized in five minutes contact. When lime is used, the reaction is much quicker, the water becoming neutral to methyl orange in five minutes, using 10% excess. This is a matter of considerable importance, bearing in mind the natural tendency for undissolved reagent to settle out quickly in the sumps, and so to be rendered of little further use. For step (2) calcium carbonate shows an initial settling rate somewhat faster than lime, but with less degree of clear settlement. For step (3) it is not as suitable as lime, as it does not precipitate the ferrous salts.

LIME. The neutralization of the free acid and acid ferric sulphate can be obtained with lime, preferably with hydrated air-separated lime. Only sufficient should be fed, so that in testing the treated water with methyl

orange indicator, the pink tint due to free acid and ferric sulphate is at the turning point to neutral. An excess of lime beyond this point will react with ferrous and magnesium salt in solution, precipitating them, and the third step, (3), is effected partly or completely according to the excess of lime added. For economic reasons and to avoid the risk of forming incrustations of calcium sulphate in the pump column, it is generally considered preferable to neutralize free acid and acid salts, (1), only, underground. At most mines it is considered safe to carry the destruction of acid not quite to the neutral state.

The settlement of the suspended solids, (2), is not affected detrimentally by the use of lime. Settling tests show that the initial settling rate is the same, using lime or soda, assuming like liquid-solid ratios. The settling rate is the most favorable with the water in an acid state, probably because there are no precipitated flocculent hydrated oxides in suspension, and the acid state supplies a condition of electrolyte favorable to settlement.

An excess of lime beyond that necessary to neutralize the free acid and acid ferric sulphate, tends to increase the bulk of the solids settled. This is usually an objectionable feature owing to lack of settling space underground. It appears impracticable to obtain water free from suspensions by settlement only in underground sumps, and some sort of filtration is required, supplementing settlement.

For reduction works purposes, the portion of the mine-water used in the replenishing of the mill-water circuit should not only be completely neutralized, but further purified, (3), that is, in addition to the free acid being neutralized and ferric sulphate precipitated, the ferrous salts and magnesium salts should be precipitated and then settled in a tank or a dam on the surface. For this, the use of lime is most economical. Where all the mine-water runs into the mill storage-water dam, sufficient lime from some source should be added to effect the above efficiently. The approved practice is to treat only such a volume of water as is necessary for surface services. The end-point test used for this treatment, (3), is a pink coloration with phenolphthalein indicator. The complete removal of ferrous and the efficient removal of magnesium salts is necessary to prevent the decomposition of cyanide. The action of the lime is to precipitate the ferrous, ferric, and magnesium salts as hydrated oxides. The ferric and magnesium hydrates are without effect on cyanide, but the ferrous hydrate must be removed. The lime assists the settlement, and the ferrous hydrate is in time oxidized to harmless ferric hydrate. The large surface exposed to sunlight and atmospheric agency in dams has undoubtedly a beneficent effect through the absorption of air.

UNDERGROUND SETTLING. With reference to underground-settling sumps, little has been known of the relative volume and weight of precipitates thrown down by the neutralizing agents, sodium carbonate, and hydrated air-separated lime. At the suggestion of the manager, to whom the matter was of considerable importance, com-

parative tests were made on untreated acid mine-water from the Durban Roodepoort Deep mine with a view to gaining knowledge on these points. A record of these tests, comparing sludges formed by soda and by lime, is as follows:

Two portions of the untreated water were exactly neutralized to the methyl orange stage (neutralization of free acid and ferric sulphate, and considered sufficient for underground purposes) with sodium carbonate and lime respectively. The volumes occupied on complete settlement and the weight of the ignited precipitates were:

	Volume cc.	Weight gm.
(a) With sodium carbonate	10.0	0.092
(b) With lime	10.5	0.097

Neutralizing two other portions to a point midway between the methyl orange and phenol stage, results are:

	Volume cc.	Weight gm.
(c) With sodium carbonate	30	0.13
(d) With lime	29	0.126

Neutralizing two other portions completely (to the phenolphthalein stage) results are:

	Volume cc.	Weight gm.
(e) With sodium carbonate	23	0.176
(f) With lime	38	0.173

These tests indicate that the volume and weight of precipitates to the methyl orange stage of neutralization (a) and (b) are practically identical. The same holds with the midway, (c) and (d), stage. Beyond this, neutralization is not apt to be carried underground. When the water is completely neutralized, (e) and (f), or to the phenolphthalein stage, the volume evidently favors the use of sodium carbonate, although the weights remain nearly equal. Where the acid content of the water is high, calcium sulphate (when lime is used) may be thrown out of the supersaturated solution and augment the volume and weight of precipitates. With soda, sodium sulphate, owing to its high solubility, would not be deposited.

RATE OF SETTLEMENT. Comparing the rate of settlement of sludge when using soda and when using lime, we have noted the following:

When neutralizing to methyl orange settlement is at equal rates, the tendency being for suspensions to remain. Neutralizing to the midway point, soda gives slightly faster settlement. When neutralizing completely the settlement rate is distinctly in favor of soda. The soda, however, does not give such a clear settled water as lime, suspension remaining. It should be noted that the rate of settlement of the sludge is in all cases much slower than that of banket-ore slime.

CYANIDE TREATMENT OF SLUDGE. Experiments were conducted on a typical sludge from the City Deep mine with the view to studying a practical method of handling, and of the subsequent recovery, of the gold content in the cyanide process. No difficulty was experienced in making a good vacuum filter-cake from $\frac{3}{4}$ in. to $2\frac{1}{2}$ in.

thickness. On account of the gelatinous nature of the sludge the residual moisture in the cake, however, remained as high as 43% and was rather soft and smeary. Using a pressure-filter press, a 2-in. cake was made in 10 to 20 minutes with a thickened pulp of from $\frac{1}{1.7}$ to $\frac{1}{5}$ solid:liquid ratio. After air drying in press for 20 minutes a hardened cake, easy to handle or transport, containing only 25% moisture, was obtained. This cake would seem to meet practical requirements.

Cyanide-extraction tests on this sludge, 99.9% of which passed a 200-mesh screen, and which assayed 1.02 dwt., disclosed interesting information. Air-agitation cyanide-treatment of the sludge taken from the sump yielded only 46% extraction, with a prohibitive cyanide consumption. The presence of deleterious reducing organic matter and ferrous salts was indicated. Similar extraction tests made on the partly air-dried filter-press cake yielded a 90% extraction with a nominal cyanide consumption. Analysis of the effluent solutions from this last test established the oxidation of the ferrous iron to the ferric state, due to the press aeration.

Filter-presses have been installed underground in a few mines, and the press cake is hoisted with the ore. In other mines the sludge is bailed out with skips, and is dumped and run into surface dams for oxidation and possible future treatment. The low gold content (the pure precipitated sludge carries no gold), due to an admixture with fine from stope washings, in many instances precludes future treatment. The great dread, from a metallurgist's point of view, is the practice of dumping skip-loads of slushy sludge into the 'fine' bins for direct transport to the mill. The ill effect on conveyor-belts, mill-feeders, battery-floors, and foundations can readily be imagined, not to mention the dismay at the slime-plant with the resultant poor settling and high cyanide consumption.

In concluding we wish to repeat that there is much important work still to be conducted on mine-water treatment in the consideration of which the engineer, the metallurgist, and the chemist are mutually concerned.

Helium

Until recently hydrogen has been practically the only gas used for filling balloons. As far as buoyancy is concerned, it is the ideal gas for this purpose, as it is the lightest of known substances. On the other hand, however, hydrogen is extremely inflammable, and before the War had progressed very far it was discovered that airships filled with it were so easily destroyed by incendiary bullets that such craft could be used only where they could be effectively protected from attack by this weapon. The officers responsible for the air-service activities of the belligerent countries had been continually seeking for some non-inflammable substitute for hydrogen, but the various attempts made to utilize non-inflammable gases in balloons were unsuccessful on account of their relatively great weight. Then the possibility of obtaining helium in

practicable quantities appeared and investigation looking to the development of a supply was begun.

Helium is next to hydrogen in buoyancy. Its weight is but twice that of hydrogen, so that in balloons, compared with the far heavier enveloping air, it exerts a lifting power of about 92% of the lighter gas. Since it is also absolutely non-inflammable, it is an all-round ideal balloon gas. Helium was first found in natural gas in Kansas in 1907. Very soon after the United States entered the War the Army, Navy, and Bureau of Mines became interested in the project of obtaining it from this source for the use of the lighter-than-air service of the United States. This work was considered of the first importance on account of the great tactical advantage which the allied forces would possess if equipped with aircraft so vastly superior to those of the enemy that attack by the latter would prove extremely hazardous, if not almost useless.

What has been said above relates but to one of what may be many important uses of helium in war and in peace. Up to recently the amount produced was so minute in quantity that helium was not much more than a laboratory curiosity. Therefore its range of properties and the consequent possibilities for its useful application in science and the arts could not be fully determined and developed, and only recently has much research work been attempted. The price paid for helium before the entry of the United States into the War was approximately \$1700 per cu. ft. It is probable that not over 100 cu. ft. had been isolated up to that time. After our entry into the War three experimental plants for the production of helium from natural gas obtained from the Petrolia pool, at Petrolia, Texas, were erected. Two of these, known as plants 1 and 2, were built at Fort Worth, the gas being supplied through a pipe-line from the former place, and the last plant, known as plant No. 3, was established at Petrolia. During the operation of these plants approximately 225,000 cu. ft. of helium was separated from the natural gas, this helium being contained in mixtures varying from 60% to 92% purity. While helium of 92% purity is suitable for use in balloons, that of lower purity must first be brought up to approximately this percentage before it can be so employed.

The cost of producing 1 cu. ft. of helium in a mixture of 92% purity in plant No. 1, the most successful plant to date, was about 39c. This shows an extremely remarkable reduction in the price of producing helium, especially when the fact that this was an experimental plant and was not of such proportions as to give lowest cost is taken into consideration. The cost of producing helium in the latest production plant, as estimated by the Navy Department, which is in charge of its construction and operation, is 5.22c. per cubic foot.—U. S. Bureau of Mines.

THE importance of the copper industry to Peruvian prosperity is brought out by the fact that roughly one-third of Peru's exports consists of copper.

Magnetic Separation of Bismuth, Tin, and Tungsten Concentrates in Tasmania

By WM. E. HITCHCOCK and J. R. POUND

*At the Launceston works of the S. and M. Syndicate, Wetherill magnetic separators are used, with accessory appliances for crushing and screening the concentrates to be treated. The concentrates are mixtures of heavy minerals not further separable by the ordinary wet-mill operations on account of their similar specific gravities. They are first crushed, as necessary, in rolls, and screened when dry through a set of shaking-screens until the whole is divided into four sizes, ranging from one-eighth of an inch in diameter downward. Each size is then treated on a magnetic separator.

The essential feature of the Wetherill magnetic separator lies in the passage of the feed on a conveyor-belt through the magnetic field between a flat pole and a V-shaped pole of opposite polarity. In such a magnetic field the magnetic particles are attracted toward the V pole from all positions except those in the immediate neighborhood of the flat pole. The machines in use at Launceston have two sets of magnets. Each set consists of two electro-magnets—the one with two V poles above the conveyor-belt and the other with two flat poles which are below the belt and opposite to the V poles. Each pair of electro-magnets is connected in series, and by regulating the strength of the electric current the lifting power of the set can be adjusted. The first pair of electro-magnets is used to pick up the strongly magnetic minerals, such as magnetite, and the second pair is used to pick up the feebly magnetic minerals, such as wolframite; the first pair forms a weak and the last pair a strong magnetic field. The dry concentrate is fed uniformly on to the conveyor-belt, which passes on top of the four flat poles and beneath the four V poles. The minerals attracted to a V pole are removed by an endless cross-belt moving just beneath it and at right angles to the conveyor-belt. As these magnetic particles pass out of the magnetic field they fall into a chute and a bin at the side of the machine. On these machines there can thus be collected from the four V poles four magnetic products, but generally those from the first two V poles form one product and those from the last two form the second product. These machines take an electric current of 20 amp. at 110 volts, each machine being provided with a d.c. generator and with appliances for regulating the current. The two generators and the whole plant are driven by a 14-hp. motor supplied with three-phase alternating current by the Launceston Corporation.

The conditions necessary for the satisfactory working of these Wetherill separators may now be summarized;

*Abstracted from the proceedings of the Australasian Institute of Mining Engineers.

these conditions also hold in general for other magnetic separators. The first essential for good working lies in the close sizing of the feed. The magnets are brought as close as possible to the material, so as to obtain the full benefit of the magnetic fields. It is evident that large differences in the sizes of the particles of the material being treated must lead to uneconomical handling of the finer portion, which could be better treated by itself. An even distribution of the particles over the conveyor-belt, which takes them past the magnets, is clearly desirable, and is ensured by means of a suitable feeding device. At the Launceston works a shaking-bar feeder is used, which moves with a set stroke at a given distance beneath a slot in a hopper bottom. Both length and time of stroke of the bar are capable of close regulation as well as the distance from bar to slot, and thus any size and variety of material may be fed as desired on to the conveyor-belt. The speed of the cross-belts, which take the magnetic particles from beneath the magnets to the side chutes of the machine, needs to be sufficient to carry the particles clear of the magnet; a speed of about 300 ft. per min. is usually ample.

The speed and width of the conveyor-belt are both important, as they largely fix the capacity of the machine. The width must not be too great, because the wider the belt the larger the air gap necessary between upper and lower poles, due to the increased space required between the conveyor and the cross-belt to allow the two streams of ore to pass. Consequently, the wider the belt the more electric energy is required to remove the same amount of any given mineral. Here, again, the magnet construction will be more difficult, for, apart from the above considerations, the amount of magnetism must be at least proportional to the width of the belt, and this must be produced by longer or thicker coils or by greater current-strength. There is a practical limit to each of these factors, so that the maximum width of conveyor-belt made on Wetherill separators used for feebly-magnetic minerals is 18 in. In the Syndicate's machines the magnet poles are 14 in. wide, the conveyor-belt being a little wider. The speed of the conveyor-belt cannot be increased beyond a certain point if the quality of the separation is to be maintained, as a magnetic mineral must remain a definite time beneath a pole in order to be attracted to it—the larger the mineral particle the longer the time. For this reason fine material may be treated with a faster conveyor-belt speed than coarse, assuming the material is one layer deep in each case. However, the actual rate of treatment does not increase indefinitely as the size diminishes. The best size of material to treat

with this type of machine is, generally speaking, minus 10 and plus 20-mesh, averaging 0.04 in. diameter. A device to vary the speed of the conveyor-belt is an advantage, as then re-treatment of the supposed non-magnetic tailing from the machine may always be avoided. The greater the amount of magnetic material in the feed, the slower it must pass beneath the magnets, otherwise the percentage of magnetic material in the tailing will increase. Such a slower feed can best be obtained by thinning out the material on the belt and by decreasing the speed of the belt. The conveyor-belt speed should be capable of variation (by steps) from about 50 ft. to about 100 ft. per minute.

The capacity of a Wetherill magnetic separator depends on:

1. The width of the magnet poles, and thus of the conveyor-belt.
2. The speed of the conveyor-belt.
3. Thickness on the belt of the layer of particles, and the size of the latter.
4. The strengths of the magnets and their number.
5. The nature of the separation desired.

It has been shown above that increase in each of the first four factors favors increased capacity, but that these factors cannot be raised above a certain limit. In practice there is effected a compromise between the development of each of these factors, a compromise largely decided by the fifth factor, which is, of course, the most important feature of any given machine.

In the case of mixtures of bismuth or tin minerals with wolframite, the treatment of which represents the greater part of the Launceston work, it is desired to obtain complete separation of the valuable minerals from one another, quite apart from the fact that penalties may be imposed on the seller of mixtures of these minerals. The Syndicate is here working under the severest conditions, and that at once precludes any record-breaking capacities. For example, users of Wetherill machines that are separating ferruginous zinc-blende (ZnFe)S, from galena, PbS , are satisfied with zinc and lead products that contain appreciable impurities, for example, a lead product assaying 50% Pb and 5% Zn, and thus it pays them to obtain capacity at the expense of completeness of separation. It is found that figures quoted from American practice on the capacity of Wetherill separators treating such ores are far in excess of those obtained at Launceston in separating concentrates containing wolframite. In the present case the quality of the separation comes first, the aim being to maintain the highest grade of products possible with any given ore, and it will be sufficient to indicate that on an average cassiterite-wolframite concentrate the rate of treatment of one machine is about three-quarters of a ton in 24 hours.

These Wetherill separators are simple to operate, easy to regulate and to clean, and the magnetic fields can be finely adjusted. The feed must be perfectly dry and of appropriate size. These machines are not suitable for slime—that is, say, material passing through a 150-mesh sieve, for such material sticks to the conveyor and cross-

belts and is carried round with them past the proper bins. Also, in falling into the various chutes and bins the slime creates dust. For slimy ores a magnetic separator that will treat the wet material is required.

There will now be considered the results obtained with these Wetherill separators on the concentrates from the S. and M. mine, Moina, Tasmania. The run-of-mine ore is there treated in a typical wet mill, from which two main grades of concentrates are forwarded to Launceston. These are known as 'firsts' and 'seconds', the former being the better product.

The S. and M. 'firsts' contain mainly bismuthinite, cassiterite, and wolframite, which are the minerals of economic importance, and together make up about 98% by weight of the concentrate. The remaining 2% by weight consists of pyrite, magnetite, scheelite, and silica. The S. and M. 'seconds' contain all the above minerals in quantity, together with small amounts of chalcopyrite, molybdenite, siderite, and other minerals. In connection with the following data approximate average results alone can be given, as the concentrates are continually changing in details, though their general characters remain the same. For instance, in the S. and M. 'seconds' the amounts of pyrite and magnetite vary considerably, and in both 'firsts' and 'seconds' the ratios bismuthinite: wolframite: cassiterite are constantly altering.

The S. and M. 'firsts', on treatment with the magnetic separators, give a little magnetite product from the first two V poles, those of the weak electro-magnet, then a wolframite product from the last two V poles, those of the strong electro-magnet, and finally a non-magnetic product of cassiterite and bismuthinite, with small amounts of scheelite, silica, and pyrite. The magnetite product contains a little magnetic pyrite and merely traces of the valuable metals. The wolframite product averages about 73% WO_3 , with 0.7% Sn, and the merest trace of Bi, while the tin-bismuth product assays in general about 63% Sn and 4% Bi, with 2% WO_3 or more, depending on the amount of scheelite present. These last two products are sold, the wolframite at present to the British government, and the tin-bismuth product to an English chemical works, where the bismuth is extracted, and the tin residue then taken by a tin-smelter. At present the magnetic separation process gives the following results from the 'firsts':

	Weight %	Assays			Recoveries		
		WO_3 %	Sn %	Bi %	WO_3 %	Sn %	Bi %
Iron minerals	0.5	...	...	...	...	...	...
Wolframite	42.5	73.0	0.7	...	96.9	0.8	...
Tin-bismuth minerals	57.0	2.0	63.0	4.0	3.1	99.2	100
Original 'firsts'	100.0	36.5	36.2	2.3	100.0	100.0	100

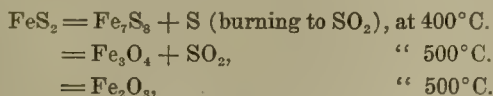
Scheelite is an undesirable mineral in the feed, as it means the presence of tungstic acid (WO_3) in a non-magnetic form, which therefore cannot be separated from the tin-bismuth product by magnetic separators.

The S. and M. 'seconds', on treatment by the magnetic separators, give three products. The first product consists of magnetite and magnetic pyrite, the former mineral predominating. The major portion of this product comes from the first V pole, and is almost wholly mag-

netite, while from the second V pole comes the minor portion, which contains the bulk of the magnetic pyrite. The magnetite occurring in the S. and M. concentrates contains some rock minerals intimately associated with it, but it is still quite strongly magnetic. This iron-product contains very small amounts of the valuable metals, and is removed as waste. The second product from the machining of the 'seconds' contains wolframite with considerable magnetic pyrite and smaller amounts of siderite and garnet or vesuvianite. The third, or non-magnetic product, contains bismuthinite, cassiterite, pyrite, scheelite, silica, etc.—that is, all the non-magnetic minerals present in the original 'seconds'. This product may contain over 50% by weight of pyrite. The pyrite in the S. and M. 'seconds' thus varies in magnetic quality, although the bulk of it is non-magnetic.

The pyritic wolframite and the pyritic tin-bismuth products from the machining of the 'seconds' are both of too low a grade to send direct to market. Advantage is now taken of the fact that pyrite may be converted into strongly magnetic sulphide and oxide of iron—approximately Fe_3S_4 and Fe_3O_4 —by means of a partial roast. The above two products are thus separately roasted, cooled, and then again treated on the Wetherill machines, when the strongly magnetic roasted iron pyrite is removed by the first weak electro-magnet, leaving the wolframite or the tin-bismuth product to be recovered later from the machine as a high-grade product.

The roasting of pyrite for magnetism is a fairly common operation being adopted on a large scale in the United States, chiefly in connection with the separation of pyrite from zinc-blende and galena, such mixtures being the middlings produced in the wet dressing of pyritic zinc and lead ores. Pyrite, on heating, decrepitates at $60^\circ\text{C}.$ and commences rapidly to lose sulphur at $400^\circ\text{C}.$ In the presence of air it thus ignites at the latter temperature, and it becomes incandescent at about $500^\circ\text{C}.$ Pyrrhotite, with a composition usually about Fe_7S_8 , ignites at about $500^\circ\text{C}.$ in air. The decomposition of pyrite on roasting may be represented as follows:



The final oxide of iron obtained will depend on the conditions. Free access of air and temperatures from 500° to $1100^\circ\text{C}.$ approximately favor formation of ferric oxide, while a limited air-supply, the presence of reducing gases (CO , H , SO_2), and extremely high temperatures lead to the tetroxide. The following table gives approximately the ignition temperatures in air of those sulphides that have a bearing on the roasting practice; the figures are taken from Friedrich's researches, as recorded, with references, in Hofman's 'General Metallurgy' (1913). The ignition temperature of a sulphide, however, varies with the conditions of the test, and especially with the size of the sulphide particles tested. The following figures refer to very fine ore, 0.006 in. diameter, approximately.

Ignition Temperatures in Air of Various Sulphides

Pyrite, FeS_2	$400^\circ\text{C}.$	Molybdenite, MoS_2	$500^\circ\text{C}.$
Pyrrhotite, Fe_7S_8	$500^\circ\text{C}.$	Chalcocite, Cu_2S	$550^\circ\text{C}.$
Ferrous sulphide, FeS	$500^\circ\text{C}.$	Bismuthinite, Bi_2S_3	$600^\circ\text{C}.$

In roasting pyrite for magnetism the aim is to get a product of uniform magnetic quality, which will consist of magnetic sulphide and oxide of iron. The larger particles, after roasting, will contain a kernel of unaltered pyrite, then a layer of magnetic sulphide, and on the outside a coating of magnetic oxide. The finer particles of roasted ore will be practically wholly magnetic oxide. Coarse ore takes a longer time to roast to a required magnetic quality than fine ore, and the ore should therefore be carefully sized before roasting. It should all pass through a 10-mesh sieve. Material of half this size, and less, behaves better as regards the roasting, but then the extra crushing and the behavior on the magnetic separators would become serious items. It is the Launceston practice to crush the 'seconds' into three sizes, from 0.05 in. diam. downward, each size being subsequently treated by itself.

At the works in Launceston the closely-sized products are roasted in a small muffle furnace, and are rabbled by hand. Air is admitted in limited quantity through the door of the muffle and the gaseous products of the roasting—sulphur and sulphur di-oxide—pass out at the farther end of the muffle and into the chimney. The cast-iron muffle is heated by a wood fire placed at one side, and the flame passes around it and then up the chimney, the draught of which also causes the air-current through the muffle. The ore-charge is about 2 in. deep, and is rabbled from 4 to 6 times per hour. The average time of roasting a charge, approximately $1\frac{1}{2}$ cwt., is $1\frac{1}{2}$ hours, or the mean rate of roasting, all S. and M. pyritic products being considered, is $\frac{3}{4}$ cwt. per hour. This is neglecting the time taken to heat the furnace on Monday morning in each week, which is about 6 hours. The furnace thus treats $5\frac{1}{2}$ tons of ore per week of six days, with a fuel consumption of $8\frac{3}{4}$ tons (1 ton = 80 cu. ft.) of firewood. This type of furnace is only suitable for small tonnages, such as are dealt with, and is thus expensive compared with larger installations with mechanical feeding and rabbling. The cost of roasting amounts to approximately £2 15s.* per ton of concentrate roasted, this being largely dependent on the life of the muffle. A good muffle ought to last out the roasting of 100 tons of pyritic ore. The great advantage of this type of furnace is that the dust losses are reduced to a minimum. The results obtained are satisfactory, as the end-point of a roast can be judged with accuracy, and small variations in the temperature, rabbling, time of roasting, and quantity and quality of the ore roasted can thus be arranged so as to compensate each other. When finishing the roasting of a charge of ore the muffle is at a good red heat, say at $650^\circ\text{C}.$ If the temperature is lower the roasting takes too long; if higher the various ore-particles frit together excessively, and the subsequent magnetic separation is adversely affected.

*\$10.40 at the present rate of exchange.—Editor.

When the roasting is approaching completion, the charge should throw off very few sparks on rabbling. During the early stages of the roast this sparking of the charge is pronounced; it is due to the decrepitation of the pyrite and the incandescence of the rapidly burning particles that are thrown up from the surface of the charge. At the end of the roast the ore will appear uniformly red hot, and will give a short flame on rabbling, not a long flame as when half done. The cold-roasted ore should be dull gray-black in color, with no shiny particles of unaltered pyrite. Only the surface should show a reddish-brown tint, due to further oxidation to ferric oxide; if there is a red-brown tint throughout, the charge is over-roasted. Ferric oxide is feebly paramagnetic, and the aim is to form the strongly paramagnetic compounds of iron. However, in practice over-roasting rarely occurs. If the ore is under-roasted, then bluish-black particles will be seen. These bluish particles contain large kernels of unaltered pyrite, and are thus only weakly magnetic. The roasted ore-particles should be very slightly sintered together. Any marked sintering or fritting together of the ore is due to the temperature or time of roasting being too great. Any sign of fusion of the bismuthinite points to the same error, which, however, with ordinary care is easily avoided. A sample of the ore may always be removed from the furnace, rapidly cooled, and examined. Under-roasting is the main thing to guard against, especially if the ore is coarse and rich in pyrite. It is generally safer to give the ore a quarter of an hour longer in the furnace if there is any doubt. In practice any lot of uniformly sized ore will have a constant time of roasting under normal conditions.

Besides the magnetic separation of its own concentrates, the S. and M. Syndicate also undertakes similar work on concentrates from other companies. These concentrates fall into two main classes:

1. Concentrates containing wolframite together with tin and bismuth minerals.
2. Concentrates containing cassiterite with valueless magnetic minerals, such as titaniferous iron ore, chromite, and magnetite.

With the first class the completeness of the magnetic separation is largely dependent on the number of associated particles present. For instance, concentrates from the All Nations mine, Moina, Tasmania, give a clean wolframite product, assaying often over 74% WO_3 , with the merest trace of Bi, the non-magnetic product consisting of bismutite, bismuthinite, and a little native bismuth, together with pyrite, silica, etc. Another example of an ideal mixture for magnetic separation is the ore from the Iris mine, Moina; the wolframite product from this ore averages 73% WO_3 , with very little tin (0.1%), while the tin product assays 73% Sn, 0.1% WO_3 . In other cases, owing to the presence in the ores of magnetic minerals such as siderite or monazite, the grade of the wolframite product is lowered. This is not so bad as when tin or bismuth minerals pass into the wolframite product, due to their association with magnetic minerals, such as the wolframite itself, magnetic

pyrite, or oxides of iron (hematite, limonite). The S. and M. concentrates suffer in this way to some extent. Certain bismuth-tungsten concentrates from New South Wales and Queensland contain wolframite much coated with bismutite, and their separation is thus imperfect. Indeed, the actual behavior of an ore on treatment by the magnetic separation process can only be exactly determined after a trial sample has been so treated. The actual testing of a few pounds weight of the material under consideration is a simple matter, and this will give definite data concerning the possible magnetic and non-magnetic products, which determine the economical aspect of the business.

In the second class of concentrates there is only one valuable mineral to be recovered. These low-grade tin concentrates come from the north-eastern districts of Tasmania, and contain cassiterite along with ilmenite, spinel (pleonaste), chromite, magnetite, monazite, etc. These last minerals have fairly high specific gravities, and are thus not economically removable from the tin ore by wet-dressing; they are, however, magnetic, and are easily removed by the magnetic separators. Thus the cassiterite is obtained along with the other non-magnetic minerals, such as quartz, zircon, and non-magnetic spinel. (Spinel, essentially MgAl_2O_4 , has a weakly magnetic to a non-magnetic character, according to the amount of iron present in the mineral; its color varies similarly, the highly ferruginous variety, pleonaste, being the tin-miners' 'black-jack'.) The raising of the grade of the tin concentrate by the magnetic separation process obviously depends on the amount of magnetic material removed, and the final grade of the resulting tin product on the amount of the non-magnetic material present. It is quite common to remove as magnetic material from one-half to two-thirds by weight of the original concentrate, thus raising the grade by 100 to 200%; for example, from 30% Sn or 20% Sn to 60% Sn. The resulting high-grade tin concentrates are readily accepted by the neighboring smelting works of the Mount Bischoff Tin Mining Company.

KWANTUNG PROVINCE, CHINA, is turning out over 5% of the entire world production of bismuth, and the deposit is being worked by Chinese coolies, armed with native grass hooks, and two large enameled basins each, according to an issue of the 'Eastern Commerce'. Shipments of bismuth from Hongkong from January 1 to August 1, 1919, amounted in value to about \$100,000, of which approximately 60% went to Great Britain and the rest to the United States.

MANGANESE ORE accounted for 95% of the ore exports from India in 1918. The shipments decreased by nearly one-third to 433,300 tons. About 72% of the total quantity went to the United Kingdom, and the remainder to France, the United States, Japan, and Italy. Almost all the wolfram ore exported (4782 tons) was shipped from Burma with the exception of 38 tons from Bengal. The United Kingdom took the total quantity shipped.

Speech by Mr. Hoover Before the Western Society of Engineers, at Chicago, on February 28

I believe that I appear before an assembly of engineers in two aspects: first, as a fellow engineer of some experience in industry; and, second, in the aspect of a citizen of some experience in food problems. I propose, on this occasion, to discuss the inter-relationship of general industry and food production and distribution, particularly as to the necessity of a fair balance between general industry and agriculture, and the need to maintain this balance by securing to the farmer more economy in the distribution of his products. There are not only engineering problems involved in this relationship, but there are in addition great social and political issues of the first importance.

In order to avoid repetition of long phrases, I propose to use the term 'agriculture' as referring to the agricultural industry, and to use the term 'industry' as limited to the production and manufacture of non-food materials.

The outstanding feature of civilization during the last century has been the increasing growth of industry as distinguished from agriculture. Many States have stimulated this side of national life until they have built up their populations far beyond the capacity of their land. We have the most profound instances of this in England and Germany. In these States, the population is today dependent upon the import, mostly from overseas, of from 30 to 70% of different food commodities through the exchange of industrial products. The very life of their people is thus dependent upon maintaining open the free access to overseas markets. From this necessity have grown the great naval armaments of the world, and the burden that they imply on all kinds and classes of population. Such nations of necessity, have engaged in fierce competition for markets for their industrial products. They have thus built up the background of world conflicts. The titanic struggles that resulted have endangered the very lives of their people from starvation. Their war tactics have in large degree been directed to strangle food supplies.

One other result of this development has been the terrible congestion of populations in manufacturing areas. All such congested populations are periodically subjected to low standards of living, of housing, and other conditions of life that make for physical and moral degeneration. In times of industrial prosperity, the standard of living increases in these manufacturing areas, but in times of industrial depression they only maintain themselves by the practical sweating of the workers. Beyond this, there is another jeopardy which has received too little attention; in times of industrial depression, whether brought about by war or by the ebb and flow of world prosperity, these populations, oppressed

with misery, turn to political remedies for matters that are beyond human control. They naturally resent the lowering of their standards of living and they inevitably resort to industrial strife, to strikes, and disorder. Their productivity, upon which the very life of the nation depends, again decreases, and their ability to buy food from abroad decreases in train with their fallen productivity, because they decrease the production of goods to send in exchange. One other result of large industrial development is that in times of industrial prosperity when the standard of living rises in general industry, it attracts into its radius the agricultural population, and immediately creates inroads into agricultural production. To some extent this is a natural balancing of forces which tends to stabilize itself in time. But there are social and political phases more important than sheer economic balances.

Years ago our predominant export was food. Then we turned to importing mouths for an expanding industry and our net export food surplus diminished to a low ebb until the beginning of the War, when it received a special and temporary stimulus. By and large our industries have been in a high state of prosperity. More favorable hours, more favorable wages, are today offered in industry than in agriculture. The industries are drawing the workers from our farms. If this balance in relative returns is to continue, we face a gradual decrease in our agricultural productivity. If we should develop our exports of industrial commodities during the next five years as rapidly as we have during the past five years, we shall by that time be faced with the necessity to import foodstuffs.

Some economists will argue, of course, that if we can manufacture goods cheaper than the rest of the world and exchange them for foodstuffs abroad, we should do so. But such argument again ignores certain fundamental social and broad political questions. These dangers have become more emphasized by experience of the War. From dependence on overseas supplies of food, we shall, by the very concern that will grow in public mind as to the safety of these supplies, soon find ourselves discussing the question of dominating the seas. Our international relations will have become infinitely more complex and more difficult. Unless the League of Nations serves its ideal, we shall have to burden ourselves with more taxation, to maintain great naval and military forces. But of far more importance than this is the fact that the social stability of our country and the development of our national life depends upon our farms and villages. These are the sources that have always supplied our country with its true Americanism, its new and fresh minds, its physical and its moral strength. In-

dustry's real market is with the farmer; it benefits by an increase of his standard of living. We want our exports to grow in exchange for commodities we need from abroad, but we want them to grow in tune with our social and political interests, and to do so they must grow in step with agriculture.

Therefore, when we sit down to consider our reconstruction policies from the War—when we sit down to plan the future development of our country—our first thought should be of the state of our agricultural industry. For the last three months I have been a member of the Industrial Commission at Washington, endeavoring to find some solution for the conflicts and social wrongs that have grown up in our industrial community. Great as is the need for constructive thought with regard to its weaknesses, the need for similar thought and similar activity is still greater with regard to agriculture.

The prime problem is to make the agricultural industry economically attractive so that it draws into its service its full proportion of American life, so that it can keep pace with industry in its rapid development. When we come to the consideration of practical measures we soon arrive at two primary facts. The first is, the farmer's main production must find its market either in the great industrial centres along the Atlantic seaboard or, alternatively, in export to Europe. In either case, the prices in normal times are made primarily by competition with the other great sources of the world's food-supply. His prices are thus only remotely regulated by the cost of production. Strict economists will argue that if the prices are unprofitable to the farmer it will ultimately correct itself by diminished production and consequent general rise in the world-level of prices. Amid the complex flow of economic forces today, these results come very slowly and in the meantime the actual result is mainly a decrease in the standard of the farmer's living. For the farmer must plant and gamble in advance on the demand. He cannot decrease his production to meet such contingencies with the facility of organized industry. Whatever the economic argument may be, the outstanding fact is that for all practical purposes the farmer's level of prices is made by the world-prices of food as interpreted at the point of delivery, and during wide periods of time he is underpaid. On the whole he has not been underpaid during the War, but recently the tide has begun to turn against him.

The second great fact that would be developed is that the American farmer receives a less proportion of the consumer's purchase price for his product than the farmer in most other civilized countries; that is, the margins between the farmer and the consumer is the widest in the world. This margin comes partly out of the consumer, but predominantly out of the farmer, for, as I have said, the prices to the consumer in the great food commodities in normal times are fixed by world forces. If we assume the basis of price is not to be remedied, the line of practical remedy to the farmer lies in decreasing the cost of placing his products into the hands of the consumer. Every cent that we can decrease

this cost contributes to the consumer, but even more largely to the farmer.

If we analyze the weaknesses of our system of distribution, we can, for purposes of discussion, divide it into three phases: their transportation, their manufacture in preparation for the consumer, and the agencies of distribution.

Our transportation has been under continuous discussion for forty years with ever-tightening regulations. I believe the great majority of our people are opposed to nationalization. Nevertheless, I doubt whether there is anyone in the United States who is not completely seized with the necessity of rigorous regulation. We are about to return the railways to private ownership under generous terms and, as I have said elsewhere, private ownership is now on its final trial. The proprietors have now to demonstrate their initiative; that they can maintain a right relation to their employees; that they can maintain their administrative efficiency; that they can keep out of national and local politics; that they can conduct these operations in the sense of complete service to the community. If it shall fail in this latter respect, our people in reaction will probably be prepared to sacrifice something of its ideals in other directions, for the supreme test of efficiency is human service.

I wish to point out one weakness in our present railway situation as bearing upon the farmer. Everyone knows of the annual shortage of cars during the crop-moving season. Few people however appreciate that this shortage of cars often amounts to a stricture in the free flow of commodities from the farmer to the consumer. The result is that the farmer, in order to sell his produce, often unknown to himself, makes a sacrifice in price, owing to a local glut. The consumer is compelled at the other end to pay an increased price for foodstuffs, owing to the shortage in movement. In proof of this, on one occasion a study was made under my administration into the effect of car-shortage in the transportation of potatoes, and we could demonstrate by chart and figure that the margin between the farmer and the consumer broadened 100% in periods of car-shortage. Nor did the middleman make this whole margin of profit, because he was subjected to unusual losses and destruction and took unusual risks in awaiting a market. The same phenomenon can be proved at times of shortage of movement in corn and other commodities.

The usual remedy for this situation is insistence that the railways shall provide ample rolling-stock, trackage, and terminals to take care of the annual peak-load. This, however, imposes upon the railways a great investment in equipment for use during a comparatively short period of the year when many commodities synchronize to make the peak movement. It imposes a burden on the entire cost of transportation. This burden of extra equipment will probably always be held to such low dimensions that we will never escape the annual delays in transport and stricture in market. Aside from this question of a peak-load, we have no doubt fallen behind in the provision of even normal railway equipment during the War.

I would like, however, to recall another partial remedy for this situation advanced many times by our engineers. That is, the possible help from improving the waterways from the Great Lakes to the Atlantic seaboard by way of the St. Lawrence river so as to pass full sea-going cargoes. It has already been determined that the project is entirely feasible and at comparatively moderate cost. The result would be to place every port on the Great Lakes on the seas. Fifteen States contiguous to the Lakes could find an outlet for a portion of their annual surplus quickly and more cheaply to the overseas markets. The result would be to take off a considerable portion of the peak-load on the trunk-line railways during the great crop-movement season. It would contribute materially to reduce this effectual stricture in the free flow of the farmer's commodities to the consumers. Of far greater importance, however, is the fact that the costs of transportation from the Lake ports to Europe would be greatly diminished and this diminished cost would go directly into the farmer's pockets. It is my belief that there is a saving of five or six cents a bushel in the transportation of grain. Although a comparatively small proportion of our total grain production flows to Europe, I am convinced that the economic lift on this minor proportion would raise the price of the whole grain production by the amount of saving in transportation. The price of export grain in Chicago in normal times is the Liverpool price, less transportation and other charges, and if we decrease the transport in a free market the farmer should get the difference. Not only should there be great benefits to the agricultural population, but it should be a real benefit to our railways in getting them a better average load without the cost of maintaining the surplus equipment and personnel necessary to manage the peak-load during the fall months. It has been computed that the capital saving in rolling-stock alone would pay for the entire cost of this waterway improvement over a comparatively few years.

The matter also becomes of national importance in finding employment for the great national mercantile fleet that we have created. In other words, instead of expending vast sums on the development of our tracks, rolling-stocks, terminals of the trunk-line railways, we should effectually substitute the other arm of transportation which we have already built, that is, our fleet.

Another factor in transportation bearing upon the problem of marketing is the control by food-manufacturing and marketing concerns of refrigeration and other special types of cars. This special control has grown up largely because, owing to seasonal fluctuations over different roads, no one railway wished to provide sufficient special cars and service for general use by all manufacturers. The result has been to build up the domination of certain concerns and stifle free competition. Much the same results have been attained by special groups in control of stockyards and, in some cases, of elevators. Where such formal or informal monopolies grow up, they are public utilities and if the farmer is to have a free market they must be replaced by constructive public service.

The second point of attack in reduction of the cost of marketing farm produce lies in the insistent removal of every impediment to free trade in produce. We have some commodities where manufacture has grown into such units that these units exert such an influence that they can consciously or unconsciously effect the price-levels of the farmer's produce. Again I am not a believer in nationalization as the solution, but I am a believer in regulation. The experience which I gained in the Food Administration on these problems during the War led to the feeling that I have expressed at that time, that such business should be confined to one line of activity just as we have had to confine our railways, banks, and insurance companies. Even this may not prove to be sufficient protection to free the market by free competition. If we have to go to regulation, however, it is my belief that it should be confined to over-swollen units and that the point of departure should not be the amount of capital employed, but the proportion of a given commodity that is controlled. The rates must depend upon the commodities in point. When such a concern obtains such size that it can influence prices or dominate public affairs either with deliberation or innocence, then it must be placed under regulation and restraint. I think our people have long since realized the advantage of large business operation in improving and cheapening the cost of manufacture and distribution, but when these operations have become so enlarged that they are able to dominate the community, it becomes of social necessity that they shall be made responsible to the community. The test that I would apply, therefore, is not the size of the institution or the volume of capital that it employs, but the proportion of the commodity that it controls in its operations. It is my belief that if this were made the datum-point for regulation, and if regulation were made of a rigorous order, this pressure would result in such business keeping below the limit of regulation. Thus the automatic result would be the building up of proper competition because men in manufacturing would rather conduct a small business free of governmental regulation than to enjoy large operations subject to governmental control. In other words, what we fundamentally want is to be free from domination of any artificial impediment in the free flow of commodities to the consumer.

The third point of attack at reduction in the cost of marketing is the most difficult of all. It lies in the fact that we have too many people engaged in distribution of food supplies. This is particularly the case in the retail end of distribution. There is one town in the United States that had one meat dealer to every 400 of population—and although their margins were very wide none of them made more than a bare living. The numbers engaged in distribution have naturally increased rapidly during war inflation and speculation such as we have gone through in the last five years. In such a period, much profit is earned by the simple process of marking up the price of goods on the shelf to the cost of replacements. I am not at all sure that we shall not find a great measure of remedy, both to the producer and the con-

sumer, now that the tide of inflation must soon turn, and there may be a process of marking down the prices of the goods on the shelf instead of marking them up.

In this connection, it is worth noting that, although agricultural products increased, yet the total commodity production of the United States has decreased by nearly 7 or 8% during the past 18 months. At the same time deposits in our credit banks have increased by nearly 20%. No one can defend this terrible increase of inflation since the Armistice. It is scarcely possible for a dealer in commodities to have escaped this magic wand of profits. If we have a wise and steady reduction in inflation, it will be a skilful dealer who escapes a reduction in the scale of profits. Whatever the result of this process may be to the distributor, it will reduce the margins between the producer and the consumer. It may also reduce the numbers of the persons engaged. Great wisdom will be required on the part of our Government in its great control of credit that this deflation shall take place progressively and with care, in order that there shall be no sudden breaks with their resulting demoralization, unemployment, and misery. One of the most effective measures in reduction of the cost of distribution has been co-operative distribution among producers. We have some successful marketing co-operations. They have proved their value both to the producer and the consumer. We have, however, never had the development of co-operation to the extent that European farmers have attained. To reach its best results, co-operation must grow on parallel lines by the consumers. As co-operative marketing does not reduce initiative or competition, I have never seen the bogie of Socialism in it.

There are other directions in which the costs of distribution can be constructively reduced on behalf of the farmer and consumer. For instance, many of our products are unstandardized; if they were standardized they could be sold by contract instead of by doubtful inspection on delivery.

We need an exhaustive economic and practical investigation into our great national boards of trades, with a view to extending their legitimate functions or preventing their abuse. The economic value to the farmer of having a daily national price created by the ebb and flow of absolutely untrammelled trade in central markets has never been fully appreciated. In commodities where such trading is wholly or partly unorganized, neither the farmer nor the consumer has any protection as to the determination of the right price and the margins between consumer and producer widen at once. Wider margins between producers and consumers is always a measure of hazard. When there is free and public market these hazards decrease. The abuses of exchange lie, of course, in the possibility of manipulation of their processes to create artificial prices for speculation. It is within the power of the speculators, and there is a tendency among them to eliminate these abuses. The War proved a great laboratory of experience in these matters, and the whole subject needs study and review.

Another field of interest in agriculture to engineers lies

in its mechanical equipment. Our American engineers have replaced manual labor by machines to a remarkable degree. This mechanical development has raised the whole economic and social status of our farmers to a point far above his European cousin. There is yet a great field of engineering for further assistance to the whole industry.

It is in all these directions that I believe lies the best field for restoration of balance between agriculture and industry. We want our industries to develop, but we want agriculture to keep pace. So long as we can feed our industrial population, the greater industry grows the greater is our whole community.

The organization and the processes of production and distribution are of centuries of development. This economic organism has come to have an extreme delicacy in its adjustment, in its response to stimulus, to effort, to the ability and character of all of the varied members of our community. Sudden disturbance and the introduction of 'isms' into this delicate organism can only bring us difficulties—can only reduce our productivity and tax our entire standard of living. We want to improve our machinery, we do not want to tear it down. Nor do we want it owned or run for the benefit of a few. The whole impulse to the maximum functioning of our productive machine lies in the self-interest of its members. It will never function on the basis of altruism. If we would have it function properly, we must promote that equality of opportunity which allows every member of this community to attain that position to which his abilities and character entitle him. To me, therefore, the test of the rightness of any measure is that it shall maintain and build up this equality of opportunity, that it shall preserve the initiative of the whole population. When we apply this test to governmental activities, I think we will find that it reaches its ideal more in negative than in positive action; that it should become positive only when the undertaking—such as a Panama Canal—is beyond the capacity of individuals or groups; that it receives its best exemplification in wise regulation against the shackling of the flow of competition, the advancement of understanding of the processes of production and distribution, stimulus to their improvement, the removal of impediments to its development, in creating in it all a pride of service to the community.

AMERICA leads the world in the talc and soapstone industry, not only in production but especially in manufacture and use. The output of talc in the United States sold in 1918, according to J. S. Diller, of the U. S. Geological Survey, was 191,477 tons, having an average value of \$10.91 per ton. This was a decrease of about 7000 tons in production as compared with that of 1917 but an increase of more than \$200,000 in value. Talc was not considered a war mineral and its production was retarded by the War, but the spread of knowledge concerning its uses and its usefulness has stimulated the industry, and a consistent increase in its application to many manufactures will be the result.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

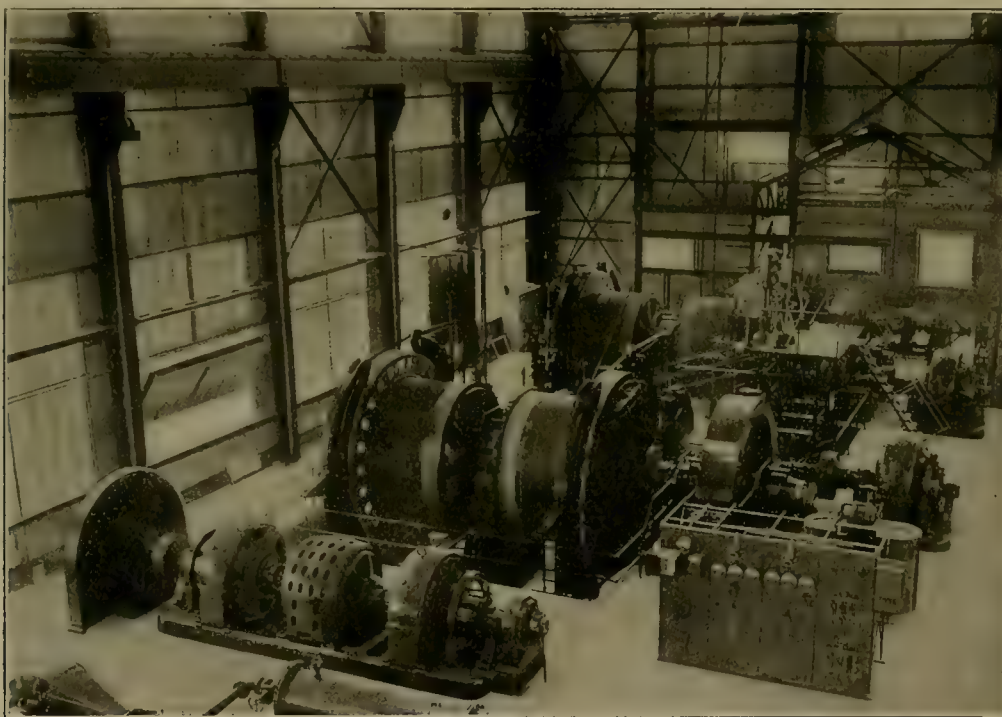
OPERATIONS OF THE JEROME VERDE COMPANY

DUNCAN.—The \$150,000 mill of the Duncan Mining & Milling Co. has been completed and is now ready to operate as soon as the mine is unwatered and active stoping can commence.

DRAGOON.—A rich body of lead-silver ore has been

driven to cut the vein at the Gates Ajar mine has opened good ore 390 ft. in from the portal. The Potosi mine formerly the Bella Union has been taken over by Charles Schoenmehl and is now being developed. R. H. Humphrey is in charge of the work.

Work on the 650-ft. level of the Gold Ore continues to show an improvement in the ore originally found in the



HOISTING-ENGINES AT THE INSPIRATION MINE, MIAMI, ARIZONA

opened on the Texas-Arizona Mining Co.'s property now being operated by lessees. The force of men working is to be increased and shipments are to commence immediately.

KINGMAN.—It is announced that the Gold Road Annex company has been financed to the extent of \$50,000 for development. The tunnel being driven on the Marybell mine at Chloride has entered three feet of shipping ore. This property is the south extension of the old Payroll and is being worked by J. C. Rankine who promoted the Arizona Butte tunnel scheme. The tunnel that is being

recent strike. Assays are said to run as high as \$42 gold, 235 oz. silver, and 24% copper. Sinking to the 450-ft. level at the Tuckahoe mine has opened a new body of shipping ore. This strike together with lateral development has prompted the management to continue sinking to the 500-ft. level.

JEROME.—It is reported that the Jerome Combination drift on the 1080-ft. level has a six-foot face of mineralized schist carrying quartz. Three to four feet of the vein is said to be concentrating ore which runs 3 to 6% copper. H. P. Henderson, consulting engineer to the

Jerome Verde company, reports that during the last quarter of the year 611 ft. of drifting and cross-cutting was done and 115 ft. of winze was sunk; and that 1072 tons of ore assaying 10.29% copper, 0.09 oz. gold, and 1.43 oz. silver was produced. A winze has been sunk 100 ft. from the 1100-ft. level in the main top shear-zone and development work is being started on the 1200-ft. level to explore the downward extension of the vein opened on the 1100-ft. level. A cross-cut driven into the hanging wall from the main top-stope at the 780-ft. level recently cut a two-inch stringer assaying 17% copper. This stringer is being followed by a drift. A cross-cut is planned to be driven 50 ft. below the bottom of the 900 main top-stope in search of the downward extension of the ore.

PATAGONIA.—The Bland Mining Co. has recently opened a three-foot vein of lead and copper ore assaying \$50 to \$60 per ton in silver. The Bland mine will have its ore treated at the R. R. Mason custom mill. S. McGinley is manager. It is reported that a strike of rich silver-copper-lead ore has been made in the Blue Nose property at Patagonia. Tests are being made on the milling ore to determine the best method of treatment. Besides the milling ore there is a large tonnage of ore of shipping grade. The property is at present being worked by the Layman syndicate.

PHOENIX.—The directors of the United Arizona Mining & Milling Co. have been enjoined from issuing any additional stock as an outcome in the damage suit being brought by S. W. Badger against the company on the grounds that there is a breach of contract which granted him the sale of the company's stock.

COLORADO

POWDER MAGAZINE EXPLODES AT SMUGGLER UNION.

LEADVILLE.—The Leadville Leasing Corporation, a recently organized company headed by Albert R. Bailey, successful lessee at the Matchless mine, has taken over four mining properties on Idaho Park, Carbonate, and Breece hills and has commenced active work on the O'Donovan Rosa on Carbonate hill. Options on other properties have been secured and may be exercised by the corporation. Silver ore running as high as 1500 oz. was mined from the O'Donovan Rosa before water drove out the operators and the mine has been closed down since 1907. The Breece hill properties include the Peoria Boy and Hartford and the fourth property is the Rattling Jack. The Peoria, Hartford, and Rattling Jack may be operated through the Yak tunnel, already connected with the Peoria at the 1180-ft. level. All of the four mines are believed to have rich lead-silver orebodies. Ore running 140 oz. silver and 0.65 oz. gold is being developed on the Gertrude, in Colorado gulch, west of the city by J. Popovich and associates. The ore is coming from a vein at a depth of 115 ft. from the surface, and the first consignment of 22 tons, shipped without sorting, netted \$816. Three other cars since shipped are of a higher value.

CRIPPLE CREEK.—Stockholders of the Cresson Consoli-

dated Gold Mining & Milling Co. will be paid a dividend of 10 cents per share on March 10. With this payment the total sum paid shareholders will be \$8,491,162. Lessees of the United Gold Mines Co., which is controlled by the Golden Cycle M. & R. Co., have made a rich surface discovery on the Hardwood claim, Ironclad hill. From prospect holes not more than 15 ft. deep a 30-ton shipment has been made which brought settlement at the rate of \$80 per ton. Operations have been resumed, after temporary shut-downs of brief duration for repairs at the Dillon mine of the Granite Gold Mining Co., on Battle mountain and the Last Dollar mine of the Modoc Consolidated Mines Co. A Wellman-Seaver-Morgan electric hoist with capacity to 2000 ft. equipped with a 3-ton skip, has been ordered for the Last Dollar shaft. Both properties have resumed production.

TELLURIDE.—The favorable effects of the open winter are noticeable in the early speeding up of production. While January and the first half of February was a period of relative inactivity, the Tomboy and Smuggler companies are now getting out heavy tonnage, and still increasing their output. The Belmont Wagner Mining Co. continues steady production, but is not yet operating at full capacity. The Cimmaron, owned by John Wagner, is still down, due to lack of water-power. The Tomboy Gold Mines Co., Ltd., is now getting out two cars daily of lead concentrate, in addition to an occasional car of flotation-slime. A gasoline locomotive has been put into operation in order to facilitate the movement of ore from portions of the workings that are not yet electrified.

A peculiar explosion of a powder magazine in the upper level of the Humboldt mine, of the Smuggler Union company, resulted in the death of one man, the overcoming by powder fumes of two men, who recovered after medical attention, and the wrecking of the main shaft that connects the mine with the Sheridan adit. The shaft and the various levels were filled with debris, so that passage from the lower workings to the upper levels is not possible, and the mine will have to be re-opened from the Ouray side, a task attended with difficulty, as a force of men will have to make a trip over the treacherous snows between the Humboldt and the Mountain Top mines, and it is feared that the explosion may have started slides.

The cause of the explosion is not known. Theories advanced are a faulty electrical circuit, spontaneous combustion, or incendiarism. The powder magazine, storehouse, and air-compressor had been placed underground, with the approval of the State mine inspector, because of the nature of the surface, which is a very steep slope subject to frequent snow-slides. The magazine contained 17,000 lb. of explosives. Fortunately the air-compressor was out of condition, and the regular force of 25 men was not at work on this level or the casualties would probably have been more.

RICO.—Nutter & Co. are shipping from the upper workings of the Iron mine. The lower workings are under water. It is expected that the new tunnel-connection with the shaft will be made in the next few days. R.

S. Pellet & Co. have undertaken the operation of the Argentine group under a lease and bond from the Swickheimer estate. There is a great amount of development work to be done, as the shaft is caved in, and the lower workings will have to be unwatered, but when the property is re-opened, there will be a large reserve of broken ore that was too low grade to ship heretofore. It is believed that all of this ore can be marketed at a profit at the present price of metals. The Aetna M. & M. Co. has acquired a lease and bond on the Aetna D. B. & B. and the Honduras claims, and contracts have been let for the driving of a tunnel.

OURAY.—The Colorado-Zanett Co. is now shipping silver-copper ore from the Portland mine, operating in the lime formation. The Early Bird M. & M. Co. is now shipping ore. The mine is under lease and bond to A. E. McCormack of Ouray, and Geo. R. Gardner of Denver. Sylstra and Hutter continue to ship steadily from the Newsboy.

CREEDE.—Three distinct zones of silver ore are reported to exist directly under the town-site of Bachelor. The discovery was made by a prospector named Monkemeyer, who was led to investigate by the finding of petrified wood impregnated with mineral. A trial shipment brought returns of \$40 per ton.

MICHIGAN

CAR SHORTAGE.—LABOR SITUATION.

HOUGHTON.—There is only one thing that is curtailing the shipment of refined copper from the Lake Superior region at present. That is the inability of the railway companies to furnish cars. The production of every smelter is being forwarded to the domestic market with all the speed possible. Railways are trying to secure cars, but they cannot keep up to the large demand, which is unusual for this time of the year. Ordinarily the smelting plants in the Lake districts commence to accumulate copper in March against the opening of navigation. There is no expectation of any great increase in output for at least six months to come. The February product was small, but there should be improvement in March and April. There is a shortage of labor at the present time, and a considerable migration to manufacturing towns is expected in the spring, which will have a bearing on possible output.

Ahmeek increased production in February. The output of 'rock' was 68,355 tons. This compares with 64,125 for January. It means that the production of copper for this mine will run over 1,600,000 lb. for February, which is a satisfactory showing for a short month. The Osceola Consolidated produced 49,000 tons for last month, a falling off from January when the output was 55,000 tons. Of this total 11,000 tons came from the old Osceola mine and the remainder from the Kearsarge.

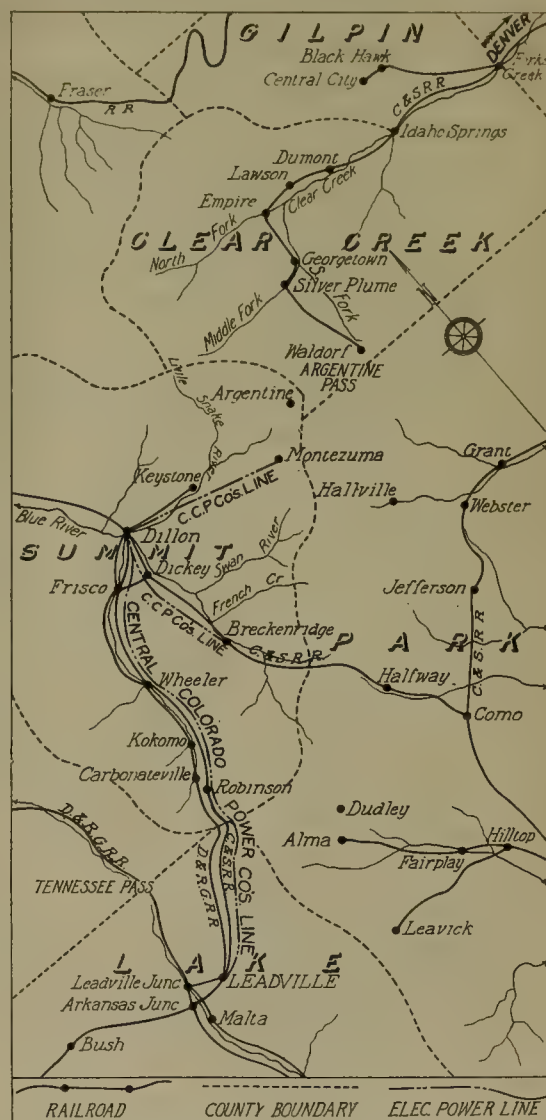
Isle Royale continues to maintain tonnage of ore with an average content of more than 19 lb. of refined copper per ton. Four shafts now are producing. No. 1 shaft is getting out the smallest tonnage of any, 7000 per month on the average; while the other three shafts, No. 4, 5, and

6 each more than double that amount. The grade of material now secured averages about the same in all three shafts and all are working at approximately the same depth. There is no present intention of resuming No. 2 or No. 7 shaft. The latter is the farthest south of all shafts but is not as deep as any of the others.

NEVADA

NEWS FROM DIVIDE.—ASSESSMENT BY GOLDFIELD DEVELOPMENT CO.

DIVIDE.—Reports coming from authentic sources indicate that George Wingfield is negotiating with New York



MAP OF CENTRAL COLORADO

men for the sale of his interest in the Tonopah Divide. It is said that sampling by engineers for the prospective purchasers has reduced considerably the estimated ore-reserves. Rumors of a merger of the Tonopah Divide,

Victory, Belchers, and other companies are persistent, but definite information cannot be secured on the subject. The first ore ever found in the 'close-in' eastern part of the district has been opened in a cross-cut driven south-east on the 400-ft., or bottom level, of the Alto. This cross-cut is 300 ft. long, extending almost parallel to the line of the Arkansas claim of the Gold Zone. The ore was found in a vein striking north at the 200-ft. point and assays of \$26 were secured from a 1-ft. width in a 4-ft. vein. A drift is being driven to prospect this vein and at 130 ft. it will enter the intersection with an important vein striking north-east. A drift is being driven south to intersect the extension of the Garrey vein of the Tonopah Divide. Ore has been found in the High Divide, but details cannot be secured.

GOLDFIELD.—A cross-cut on the 300-ft. level of the Silver Pick has entered the Mohawk vein in a block leased from the Goldfield Development Co. The vein has a slight dip and only a small part on the foot-wall side has been exposed. The cross-cut entered the vein at a point 20 ft. north of, and 20 ft. beneath, where ore of shipping grade was found one month ago. The cross-cut will be continued to the hanging wall. The Florence Divide has relinquished the lease held by the company on the Florence and the block is being prospected by the Cracker Jack. Five miners, some former lessees in the Florence, have started repairing the No. 1 shaft of the Jumbo Extension, having secured a lease on a large block. They will work on the 600 and 800-ft. levels, which are in bad condition. A winze on the west-dipping shale has been sunk 50 ft. from the 815-ft. level of the Grandma. A raise has been driven 35 ft. from the 375-ft. level of the Great Bend to open the extension of orebodies found on the 236-ft. level. Ore of milling grade is exposed in the raise. The thirteenth annual report of the Goldfield Consolidated Mines Co., covering operations during 1919, states that the mill clean-up by the company in the early part of the year yielded \$124,672 and that a clean-up by a lessee which followed gave a net return of \$78,600, of which the company retained as royalty \$42,834. Mine and mill equipment amounting to \$24,492 was sold during the year and the estimated value of the equipment now on hand is \$105,012. In referring to the Development company, E. A. Julian, general manager for the Consolidated, says: "In the event that company definitely decides to proceed with plans now contemplated additional milling equipment will be installed by it sufficient to increase the capacity of the mill to 1500 tons per day." All of the equipment at Aurora, which was owned by the Consolidated company, has been sold with the exception of material valued at \$57,699, and since the report was issued arrangements have been made for the sale of the remainder. Cash in bank is \$284,540 and the surplus is \$898,100. The report states that "it is the opinion of the management that without question the loan to the Dolly Varden Mines Co. (\$172,292) will be paid in full during the early part of the coming year". The net realization from operations of the Goldfield Development Co. was \$70,727.

The Goldfield Development Co. has issued notice of assessment No. 1, at the rate of three cents per share, payable immediately and delinquent April 3. A statement of receipts and disbursements from February 1, 1919, to March 2, 1920, accompanying the notice of assessment, shows \$107,497 received from the sale of stock, \$36,000 from loans, and other receipts, principally from shipments of ore, making a total of \$278,516. Mining costs were \$71,790; construction and equipment, \$12,252; expense in selling stock, \$8543; storehouse expense, \$6018; pumping cost, \$7792; mill repairs, \$43,554. Total expenditures were \$276,901, and the balance on hand March 2 was \$1614. The report states that in November 1919 the mill was in condition to treat 600 tons of ore daily and that the mines could have been prepared for the production of a large tonnage by the expenditure of an additional \$20,000. To secure money to carry out the plans at that time the capital stock was increased 1,500,000 shares, only a small part of which the company has been able to sell "owing to adverse financial conditions". The report is signed by A. I. D'Arcy, general manager. Mr. D'Arcy recently stated that the mill would start treating 500 tons of ore daily on April 1. The report says: "We now plan to develop the high-grade milling ore exposed in the Florence and to watch development of the Silver Pick and Cracker Jack, and as soon as this development shows a sufficient tonnage of high-grade milling ore it is our intention to start the mill on a smaller tonnage of this higher-grade ore, and to gradually build up the tonnage and lower the grade to the point first contemplated in our large tonnage operations." The Cracker Jack is a company distinct from the Development which holds a lease on the Florence. In referring to the rich ore recently reported by Mr. D'Arcy to have been found in various parts of the mines, he says: "None of these exposures have produced an appreciable tonnage." The maximum tonnage it is planned to treat in the mill is given as 1500, instead of 2000 as in previous statements.

COPPER MOUNTAIN.—Plans for further work by the Jumbo-Copper Mountain, controlled by stockholders of the Jumbo Extension of Goldfield, definitely have been abandoned. The company plans to take over a prospect in another district and raise funds for development through an assessment.

SILVER PEAK.—The Silver Peak Chemical Co. has bought a group of 10 claims adjoining the original holdings 9 miles north-east of Silver Peak. The company is building a leaching-plant to treat what is said to be the only known deposit of water-soluble potash alum.

OREGON

REPORTED DISCOVERY OF PLATINUM IN SIXES RIVER DISTRICT.

GOLD HILL.—The placer miners of south-west Oregon are feeling blue just now because the dry weather and the lack of snow in the mountains has lowered the water in the streams to such an extent that all placer mining is coming to a standstill.

CURRY COUNTY.—Platinum ore, according to report,

has been uncovered along the Sixes river in the western part of the county. The deposits have been traced for nearly twenty miles in a north-easterly direction, ending near the mouth of the Sixes river, and some of the assays run as high as 18 oz. per ton. Many claims are being staked along the line of discovery by locators from Marshfield and Bandon. Mining men of the region doubt the character of the find, although platinum ore was found in the Highland gold-quartz mine in the Gold Hill district in Jackson county as early as 1916.

Placer mining has been carried on for more than thirty years in this district, and in later years lead to considerable activity in quartz mining and the recovery of platinum from hydraulic placer operations. The country rock of the district is predominantly shale, sandstone, and conglomerate of the Dothan and Myrtle formations, with frequent intrusions of basic igneous rocks, which are altered in numerous places to serpentine. A considerable area of greenstone is found in the headwaters of the Sixes river near Rusty butte in the Salmon mountains and an area of basalt is found in the north-central part of the district. Wagon-roads are confined to regions near the coast and trails are the only means of transportation in the main part of the district.

UTAH

ZINC-OXIDE PLANT AT SALT LAKE CITY.

SALT LAKE CITY.—Construction of a zinc-oxide plant by the Utah Zinc Co. has been started. The plant will be situated five miles south of Salt Lake City. It is estimated that the first unit will cost \$150,000, and the capacity will be 40 tons per day. The Wetherell process will be used. The product of the plant, which will treat only oxidized zinc ores, will be a high-grade zinc oxide, much used in the making of automobile tires, as it gives rubber the power to withstand weathering agencies. Zinc oxide is also used in paints as a filler. The main supply of ore for the plant will come from the Tecoma mine, $2\frac{1}{2}$ miles south of Tecoma, Utah, on the Southern Pacific railroad. The new plant is expected to be in operation by June 1. The directors of the company are: L. B. McCornick, Melvin H. Sowles, Herbert Salinger, L. D. Forman, and James W. Wade.

At the meeting of the board of directors of the Utah Copper Co. in New York City on February 25, a dividend of \$1.50 per share was declared, payable March 31. This will call for a total payment of \$2,436,735. During 1919 the company paid its stockholders a total of \$6 per share.

EUREKA.—The Ridge & Valley Mining Co. had an output of 6447 tons of ore during 1919, from which was produced 105,011 oz. of silver and 2,044,280 lb. of lead. The gross proceeds amounted to \$181,602, while total expenses were \$167,024, leaving net proceeds for the year of \$14,578. The Gemini Mining Co., another of the McChrystal properties, mined 7804 tons, from which was produced 143,983 oz. of silver and 1,499,820 lb. of lead. The gross proceeds were \$201,577, while total expenses were \$222,538, leaving a deficit of \$20,962.

Eighteen mines in this district shipped 149 carloads of

ore during the week ending February 27, as compared with 138 cars the previous week. The Chief Consolidated shipped 33 cars; Tintic Standard, 25; Iron Blossom, 15; Centennial Eureka, 15; Dragon Consolidated, 10; Eagle and Blue Bell, 10; Colorado, 7; Grand Central, 7; Gemini, 5; Victoria, 5; Mammoth, 4; Ridge and Valley, 3; Swansea, 3; Martha Washington, 2; Bullion Beck, 2; Eureka Hill, 2; Empire Mines, 1; and Sunbeam, 1.

It is understood the Tintic Standard company is considering the erection of a milling plant. Some time ago it was announced that the company had secured a large tract of land and water rights near Warm creek. The company is now building a switch from the main Tintic



MAP OF UTAH

line of the Rio Grande railroad to this mill-site. It is anticipated that the construction of the spur track will be completed within the next two weeks at which time the equipment for the mill buildings will be delivered and construction started. The machinery for the mill has been ordered and it is hoped to have the plant in running order before the summer is far advanced. Conditions throughout the Tintic Standard mine are reported to be satisfactory and the present output amounts to about three carloads per day.

AMERICAN FORK.—The Treasure Hill Mining Co. in American Fork canyon has more than 300 tons of high-grade ore piled on the dump awaiting the coming of spring when shipments can be started. Operations at the present time are being carried on through the upper tun-

nel of the Silver Dipper property. The Treasure Hill Co. has taken over the Emma group, the Silver Dipper, Daniels group and Bredermeyer group, in addition to having a right of way through the Non-compromise claim owned by the Holden interests.

BINGHAM.—At a meeting held by the striking miners in Canyon hall on the afternoon of February 29, a vote was taken to declare the strike off. Albert Wills, State organizer of the I. W. W., chairman of the meeting, could not stem the tide in favor of going back to work. It was estimated previous to the meeting that all but 100 of the miners who obeyed the strike summons had either returned to work or sought employment in other camps. Many of the miners took up their tools following the mass meeting held recently in the Commercial club, at which it was voted to appoint a committee from the workers to meet with the operators.

PARK CITY.—On the 1800-ft. level of the Ontario mine, the lowest working level at the present time, ore is being followed both east and west, according to Newton Dunyon, superintendent. At the start the ore, which averages 50 oz. in silver and from 10 to 12% lead, was found in the bottom of the drift. For the last 100 ft. the ore has bedded out from the fissure for a distance of from 20 to 25 ft., with a thickness of 3 ft. The shaft to the 2000-ft. level and the drift on this level have been unwatered. After cleaning up this drift, development work will be immediately undertaken. An orebody of good size has been opened up by No. 7 and No. 8 raises from the 1700-ft. level. No. 8 raise, from a point approximately 30 ft. from the 1700-ft. level to the 1500-ft. level, has been continuously in ore. No. 7 raise, about 150 ft. west of No. 8 on the same fissure, encountered the orebody about 30 ft. above the 1700-ft. level.

At the annual stockholders' meeting of the Silver King Consolidated Mining Co. of Utah, which was held February 28, the following board of directors was elected: Solon Spiro, William Pischell, Herman Harms, D. L. Wertheimer, Richard P. Morris, Sherman Fargo, and Harry A. Lee. Despite the fact that two months time was lost during 1919, because of the labor strike in the district, the tunnel being driven by the company was advanced a total of 2622 ft. The face of the tunnel on January 1, 1920, was 11,623 ft. from the portal and is now reported to be 12,200 feet.

Ore shipments from the mines of the district for the week ending February 27 totaled 2400 tons as compared with 2264 tons for the previous week. Ontario shipped 714 tons; Judge Smelting, 648 tons; Silver King Coalition, 492 tons; Daly-West, 230 tons; Naildriver, 165 tons; and Daly, 52 tons.

MILFORD.—According to J. G. Scott, general manager of the Monitor mines, located near here, an important strike was recently made in the lower adit at an approximate distance of 118 ft. from the portal. The ore, so far as present developments indicate, contains silver and lead, with considerable iron. It is thought that this is a continuation of a streak which, in the workings 225 ft. above, assayed 30 oz. silver, 46% lead, and 1% copper.

WISCONSIN

NUMEROUS NEW PROPERTIES ARE BEING OPENED ON THE ZINC-RANGES.

LIVINGSTON.—The New Jersey Zinc Co., operating mines on the Coker zinc-range, has recently developed three mines designated as Coker, No. 1, 2, and 3. A new shaft is in ore on No. 2, and a new power-plant is nearing completion at No. 3. In addition new homes for employees have been constructed. No. 3 is on the old Sunset property and is a continuation of the same ore-range that extends through the other properties. Miners declare there is more zinc ore in sight now than ever before in all the forty years these lands have been mined.

Stockholders of the M. & A. Mining Co., operating the Big Tom mine, at a special meeting held at Platteville recently, voted to resume operations after a shut-down lasting more than a year. A new reservoir is being constructed while the mine is being unwatered and minor repairs and renewals are being made to the mill equipment. It is believed the plant and mine will again be at work by March 15. The Big Tom was a heavy producer of low-grade ore and was shut-down after the War on account of low prices for zinc concentrate.

The B. M. & B. Mining Co., operating the Squirrel mine, has driven to connect with new discoveries determined by drilling, and ore production is again under way. Estimates place the yield at from 30 to 40 tons of high-grade zinc concentrate per day. The Biddick mine, another low-grade producer in this district, is ready to resume output after a long shut-down due to low prices for ore. The Vinegar Hill Zinc Co. has two mills in operation and is making from 1000 to 1200 tons of zinc ore monthly. This product is delivered to the National Zinc Ore Separators, at Cuba City, for electro-magnetic separation.

MINERAL POINT.—The oxide-furnaces of the Mineral Point Zinc Co., four blocks of 12 double compartments, are again operating after a year or more during which but two blocks were kept hot. The working force has been largely increased. Private warehouses, in addition to the company's own, have been emptied by recent shipments.

PLATTEVILLE.—The Block-House Mining Co., after a shut-down lasting nearly a year, has decided to resume production of zinc ore. A new power-plant and derrick have been completed 1000 ft. east of the mill and a new shaft is bottomed in ore. A surface-tramway connects mine and mill. On the Goke farm ore has been proved with drills, and construction work on a new 150-ton zinc-mill has been begun, which when complete will give the Block-House two active plants. The ore has been proved ahead of the Goke tract and should market conditions warrant, a third mill will be built. The owners of this mine declare they have ore to last thirty years blocked out. Two magnetic-separating plants are treating product piled up in bins prior to the shut-down. Employment will be given to a hundred employees including mill men.

MILBRIG.—The Graham mine, one of the producers in this field operated by the Vinegar Hill Zinc Co., is ship-

ping steadily. Drills are at work proving the Ginty farm south of the Graham and future developments are contingent on what is developed on this tract. Discovery of zinc ore in quantity will warrant the removal of the Graham equipment to the new field as the Graham mine it is officially declared has about been exhausted.

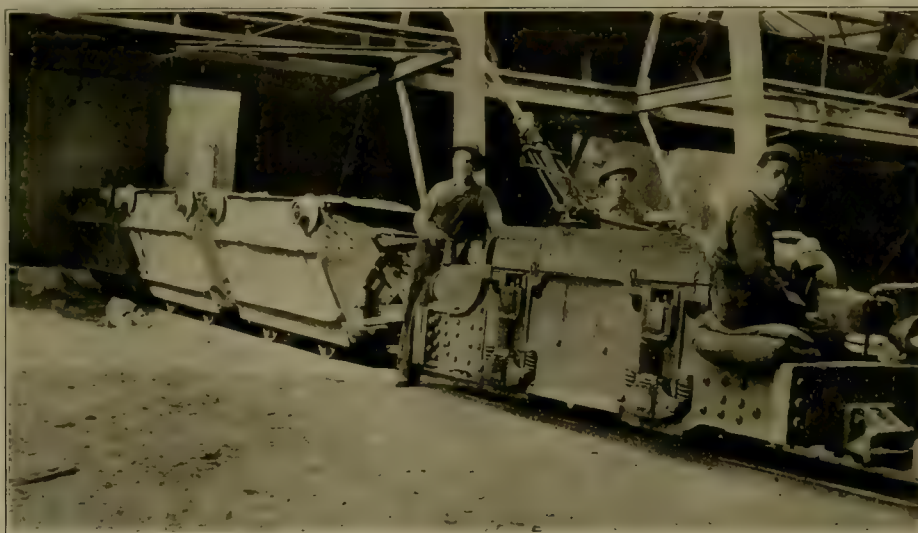
GALENA.—The New Jersey Zinc Co., owner in fee of the Marsden lands on which the Black-Jack mine is situated, has in this property an exceptionally consistent producer. The land was first mined for lead in 1854. In 1877 it was taken over by the Illinois Zinc Co., and was known as the Peru mine. It was abandoned in 1883. Records show at times as many as 150 miners employed and shipments of zinc ore amounting to 400 tons monthly.

important to our mining industry that all possible knowledge of British Columbia geology shall be made available.

And be it further Resolved, That this Legislative Assembly of the Province of British Columbia does strongly urge the Dominion Government:

(1) To take some immediate action to prevent further depletion of this most valuable branch of the Civil Service: (2) To offer adequate inducements to engineering and scientific students of Canadian universities to undertake training with a view to employment on the Geological Survey of Canada, in order to provide trained men for the future.

STEWART.—The Portland Canal Tunnel property, on Glacier creek, a tributary of Bear river, is to be re-



AN ELECTRIC ORE-TRAIN AT GRAND FORKS, BRITISH COLUMBIA

The mine was purchased by the New Jersey Zinc Co. from the Black-Jack Mining Co., organized in 1906 and operated by this corporation until 1908. The mine sold for \$360,000.

BRITISH COLUMBIA

RESIGNATIONS OF GEOLOGISTS.—NEWS FROM PORTLAND CANAL REGION.

VICTORIA.—Resignations of members of the Geological Survey of Canada have developed a serious situation insofar as the Province of British Columbia is concerned, because some of those who have been engaged in geological work in the Province for years have left the service without completing important work. Wm. Sloan, Minister of Mines, has given notice of his intention to move a resolution from which the following is abstracted:

Be it Resolved, That this Legislative Assembly of the Province of British Columbia expresses its appreciation of the great value of the work of the Geological Survey of Canada as assisting the mineral development of this Province, and views with apprehension the depletion of the survey staff, especially at this time, when, with the world entering upon a period of reconstruction, it is most

opened. In the 'boom' of 1910 a tunnel was driven for a considerable distance into the mountain and several ore-bodies were cut, but were not explored to any extent. It is proposed to continue the tunnel and to drive on the orebodies. The Anglunian Syndicate, a Belgian corporation capitalized at \$50,000,000 with offices in New York, San Francisco, and Montreal, has added the Independence and Independent groups to the already large number of properties it has under option. W. A. Meloche, representative of the syndicate, arrived at Stewart on February 19, bringing with him 200 tons of supplies. The syndicate will start operations on the Northern Light, Cobalt, and Woodbine groups, which adjoin the Premier property to the north and west, and on the Spider group, on which unusually rich ore was uncovered last fall by surface-stripping and open-cutting. The Citizens Association has posted notices on the wharf, stating that no orientals are desired in the camp. The recent labor strike at the Premier mine is said to have been caused by the employment of a Chinese cook at the boarding-house. A transportation agent is responsible for the statement that more than 700 passengers are booked from Europe directly to Stewart. It is stated that

the Grand Trunk Pacific company will put larger boats on the route as soon as the wharf has been repaired. Seattle interests have purchased the Empress hotel, and will remodel and furnish it. The hotel, which has 80 bedrooms, was erected during the previous boom. The face of the cross-cut at the New Alaska is in good ore. The faces of both tunnels at the Forty-Nine are in ore. Operations have been suspended at the Mineral Hill group, pending re-organization of the operating company. The property is to be taken over by the Mineral Hill, Ltd., of which J. W. Stewart is president.

PRINCE RUPERT.—Good progress is being made with the new tunnel at the Silver Standard mine, near Hazelton, and it is expected that the main vein will be cut by the end of March. Several stringers of rich ore have been cut. The mill has been closed temporarily for a thorough overhauling, and it is possible that a flotation plant will be added. The mill treats about 25 tons of ore per day, the crusher and jigs being run for 8 and the tables for 16 hours, but the extraction is low and the concentrates produced contain about 35% zinc and 35% lead, respectively. Both concentrates are rich in silver. The Golden Crown group, near Usk, is being developed by the Kleanza Co. The vein, which contains gold, silver, and copper, is said to have been traced by open-cuts for three miles. Diamond-drilling will be started in the spring. The Taltarpin Mining Co. is developing a 4½-ft. vein on the Silver Fox group, which assays up to \$800 per ton. The property is situated on Anderson creek.

NOVA SCOTIA

A NEW STEEL-PLATE PLANT.

SYDNEY.—A notable advance in Canadian metallurgical industry is marked by the opening of the new steel-plate mill of the Dominion Steel Corporation, which is now in steady operation. The output has been tested and found fully equal to the requirements of Lloyd's. The mill, which was erected at a cost of approximately \$5,000,000, was built under an agreement with the Canadian government, which, to ensure a market for the output, contracted to take 50,000 tons of ship-plates per year for a term of five years at \$3.65 per 100 lb. The total capacity of the plant is given as 12,000 tons of ship-plate per month, but other varieties of plates will be turned out. The enterprise has been established at an opportune time, as the iron and steel industries are at present badly handicapped by the shortage of the supply of steel from the American mills. The plates made for the Government are shipped to the Halifax shipyards.

ONTARIO

PORCUPINE NEWS.—PLAN TO BENEFIT RETURNED SOLDIERS.

PORCUPINE.—As was anticipated the option held by the Dome Mines on the Dome Extension property, which expires March 15, has been extended to September 15. A report of operations on the Dome Extension states that up to the end of November about \$30,000 had been expended in exploration and opening up the orebodies. On the 600-ft. level an elliptical orebody of about 14,000 sq.

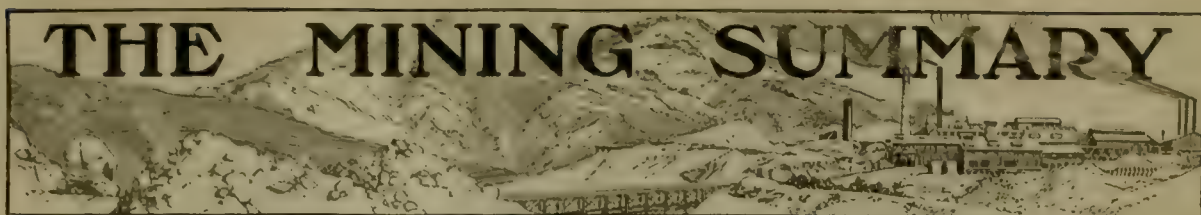
ft. in area had been developed, samples from which averaged \$4.62 per ton. However, 267 ft. of channel sampling in the better part of the deposit gave an average assay of \$5.37, and 4878 tons of ore had been sent to the mill having an average grade of \$4.39. Work under the option had been greatly retarded by shortage of labor and water in the workings in excess of the capacity of the pumping plant. The main shaft of the Clifton-Porcupine has been put down 225 ft. and a station cut at the 200-ft. level where preparations are completed for lateral work. Cross-cutting is being started to open up veins which yielded satisfactory results on the 100-ft. level.

KIRKLAND LAKE.—During January the Lake Shore made a new high record treating 1765 tons of ore with a production of \$45,428, being an average recovery of \$25.80 per ton. The Tough Oakes is not expected to resume operations for at least another month, as H. H. Johnson, the general manager, is still absent in South Africa and may not return for some weeks. The proposed merger of the company with the Burnside, Aladdin, and Sylvanite is making slow progress. It is understood that the English companies owning the Aladdin and Burnside have gone into liquidation as a preparatory step to the merger, but it is regarded as doubtful whether the Sylvanite will be included in the amalgamation. At the Bidgood a mining plant, including a compressor with three drills, is being completed. The shaft will be put down to 100 ft. and a level run for drifting on the vein which has a width of 8 ft. A cross-cut will be driven to cut a vein that outcropped over a width of 25 ft. on the surface.

COBALT.—The Keeley mine, in South Lorrain, after lying idle for a number of years was re-opened on March 9. The operating company, the Associated Gold Mines, Ltd., of Western Australia, announces that a 20-stamp mill will be erected this year. This will eliminate the former heavy expenditure for transporting the ore by truck and steamer to the railway. The Buffalo Mines has gone into voluntary liquidation, a winding-up order having just been made. March 13 is the date set for creditors to record their accounts.

Another shoot of high-grade ore has been discovered in the Temiskaming mine. Somewhat similar shoots were opened up during the past year, but they were comparatively limited in extent. For that reason, the management makes no attempt to estimate the importance of the present find before carrying on more work.

The Cobalt branch of the G. W. V. A. is urging the Ontario government to grant all returned soldiers who were bona fide prospectors prior to enlistment, three free mining claims of 40 acres each. It is estimated that about 10,000 men would come under the grant. This would involve the surrender of about 30,000 claims or approximately 1,200,000 acres, and would comprise an area equal in extent to 52 townships of the size of Tisdale township in which are located the producing mines of Porcupine. It is not thought that the Government will accede to the request, but may suggest other benefits for the returned prospectors.



ARIZONA

Wickenburg.—The Abe Lincoln Copper Co. is building a 100-ton flotation plant, some of the equipment having already arrived at Wickenburg. The equipment which includes ball-mills, tables, flotation machines of the new oscillating-cell type, and an Oliver filter, will be operated by gasoline engines. Walter N. Burke is consulting engineer for the company and is supervising the construction work.

CALIFORNIA

Amador County.—Extensive damage is feared as a result of a fire raging in the Kennedy mine. The presence of gas recently directed attention to the possibility that the workings were afire. The blaze first was discovered at the 3330-ft. level. All operations in the mine have been suspended, 140 miners being laid off until the fire is extinguished. The fire is believed to have spread into the Kennedy mine from the workings of the Argonaut mine, which is an adjoining property. The underground workings of the two mines communicate.

Both mines have been productive gold yielders and among the deepest gold mines in the United States.

Bishop.—The Sam Piper mine has passed under bond and lease to L. L. Mushett of Tonopah. This property produced silver-lead ore in 1870, and was worked in a small way for several years prior to 1890. A three-foot vein of silver ore has been found. Mushett and associates have also acquired claims at Lincoln and arranged for a carload shipment.

Forbestown.—James H. Kendall, of Berkeley, has acquired the Denver mine, in this district, and the Beehive at Woodleaf. A large tonnage of mill ore is exposed and the erection of a 30-ton Gibson mill is to start at once. More units will be added if conditions warrant. The Beehive workings are being cleaned out preliminary to opening of new ground.

Forest Hill.—A ball-mill and flotation plant has been completed at Snow Bird, and ore is going steadily to the mill. Mine developments are proceeding with satisfactory results. The Snow Bird was operated several years ago by John De Lorsi, but is now owned by George McCall and Edward Lewis. Driving of the cross-cut tunnel on the Georgia Hill group is progressing with the purpose of cutting the ore at a point 1500 ft. from the portal. Prospecting at Spanish Ledge has exposed promising ore. New equipment has been received.

COLORADO

Mayday.—Avery and Brandiger, lessees on the Idaho, are shipping about two cars per month from a 3-ft. vein assaying 2½ oz. gold with some silver. The Jumbo Mining Co. is shipping a car per week from the La Plata mine which is said to carry 14 oz. per ton in silver. Paul Dalpra has secured a lease on a block of the Jumbo and has sent out 200 sacks of ore which is reported to run 23 oz. per ton in silver. John Graves is driving a 600-ft. cross-cut at the Graves to explore a 14-ft. vein assaying 0.20 oz. gold and 3 oz. silver. The breast of the cross-cut, which is in 400 ft., shows an 8-in. streak of quartz assaying 0.60 oz. gold and

4 oz. silver. Shipments made from this property have assayed from \$14 to \$200 per ton.

IDAHO

Coeur d'Alene.—Development work has been resumed on the property of the Iron King Mining & Milling Co. The mine is situated a few miles west of Wallace and the work is in charge of A. P. Reinsardt. About 3000 ft. of development work has been done on the property, but for the last few years it has been idle. The Paragon Consolidated Mining Co., controlled by St. Paul capital, has purchased from Spokane interests all of the holdings of the Murray Hill Mining Co., situated on Paragon gulch, ½ miles east of Murray, for a reported consideration of \$100,000 cash.

Hailey.—What promises to be an exceedingly rich body of ore has been discovered in the Lark claims 2½ miles southwest of Bellevue. The find was made by Werry brothers and Schaufelberger, and consists of 4½ ft. of galena ore containing 70% lead and 250 oz. of silver per ton.

Lakeview.—Reports indicate that an active season is to be expected in that district. The principal properties of the district are the Webber, Keep Cool, Conjecture, Rainbow, and Venezuela. The only one operating now is the Conjecture. The Webber and Rainbow groups were recently examined by an engineer representing British Columbia capitalists and it is understood that negotiations are now in progress for the sale of these two.

MISSOURI

Joplin.—The Waco Mining Co. expects to start its No. 3 mill by March 15 and to continue steady operation thereafter. The plant is one of the best built and equipped of any in the tri-State district. It is of 1000 tons capacity per shift and up to date in every respect. Before starting to erect the mill the company carried out extensive drilling, proving an orebody that will provide continuous operation of the mill for several years.

The Mine LaMotte, one of the famous lead mines of southeast Missouri, is the subject of a controversy in court, in which action has been started to bring about proceedings to foreclose the \$1,000,000 mortgage against the property, which has been in the hands of a receiver for several years, and to terminate the receivership.

MONTANA

Butte.—The Anaconda company is cutting a station on the 1000-ft. level of the Orphan Girl property. It is expected that cross-cutting to the Anglo-Saxon vein will be started. The vein was opened on the 500-ft. level, where it is said to have a width of 30 ft. and to contain silver ore assaying about 14 oz. per ton.

A shortage of miners is reported to be preventing the operation of the mines upon as large a scale as was planned when a number of shafts were re-opened in January. The Bell & Diamond and Silver Bow mines of the Anaconda company have curtailed operations. Even with the two shafts closed, the lack of a sufficient number of miners is acutely felt. All available men are at work and from 600 to 700 would be employed if they could be found, according to W. B. Daly, assistant general manager of mines.

UTAH

Alta.—Recently the Big Cottonwood Coalition Mines Co. bought a controlling interest in the Copper King Mining Co., which owns eight full claims adjoining the property of the former. This gives the Coalition company the apex on all the important fissures which traverse the property, according to C. E. Robertson, secretary and treasurer. Development work has been carried on all winter and is being steadily pursued. Since the company began operations on June 1, 1919, the face of the main adit, which is being driven to cut the Prince of Wales fissure at a vertical depth of 1000 ft., has been advanced a distance of 550 ft., until now the tunnel has a total length of 2575 feet.

WASHINGTON

Seattle.—Mining men from several Western States, Alaska, and British Columbia are expected to attend the Seattle sessions of the International Mining conventions to be held April 7 to 10. Henry Landes, head of the mining department of the University of Washington, who is chairman of the program committee, expects 1500 to attend.

Invitations to speak at the convention have been sent to Herbert Hoover, president of the American Institute of Mining Engineers; Horace Winchell, past president of the Institute; T. A. Rickard, editor of the 'Mining and Scientific Press'; and George Otis Smith, head of the United States Geological Survey.

Moving picture stories of the coal, petroleum, and copper producing industries are to be exhibited at the convention. Round-table conferences will be held.

Obituary

Hennen Jennings died on March 5 at Washington after a long illness. He was born at Hawesville, Kentucky, in 1854 and graduated from the Lawrence Scientific School at Harvard in 1877. After graduation he came to California and became associated with Hamilton Smith, H. C. Perkins, and Ross E. Browne. He was engineer successively at the North Bloomfield and New Almaden mines in California. In 1886 he married the daughter of John C. Coleman, one of the two brothers that owned the Idaho mine at Grass Valley. A year later he went to Venezuela as manager of the El Callao mine, remaining there two years. In 1889 he went to the Rand, as engineer to Jules Porges & Co., the predecessors of Wernher, Beit & Co. He became consulting engineer to the firm, retaining this important position until his retirement in 1905, spending the last seven years in London, where he was a recognized leader of the profession. In 1903 he was elected president of the Institution of Mining and Metallurgy; in 1904 he was re-elected and also received the gold medal of the Institution in recognition of his efforts in behalf of technical education. On his return to the United States in 1905 he settled at Washington and served as consulting engineer to the Conrey Placer Co. in Montana, an enterprise in which, through a bequest, Harvard had acquired a large financial interest. In later years he was consulting mining engineer to the U. S. Bureau of Mines and in 1918 he undertook an investigation of the gold-mining industry. His career was long, useful, and full of honor. A man of keen public spirit, he took a leading part in the efforts to promote technical education in South Africa, England, and the United States; he gave his help to the betterment of the profession and to the welfare of all those engaged in mining. A man of cautious, rather than of brilliant, mind, he proved a rarely sagacious adviser to the financial house identified with the biggest operations known to the modern world and steered it safely through periods of dangerously speculative excitement. He was loved by many and respected by all. To his son he leaves an honorable tradition and to his friends a happy memory. T. A. R.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

W. J. Loring is in New York.

T. J. Jones is at San Mateo, California.

Herbert J. Daly is in Western Australia.

Joseph Errington, of Oakland, has gone to Vancouver.

R. H. Stretch has returned to Seattle from southern California.

Frank R. Wicks has opened an office as consulting engineer at 1006 South Hill St., Los Angeles.

James G. Parmelee, formerly at Salt Lake City, is now with the Hardinge Company in New York.

Jay A. Carpenter, formerly at Tonopah, has established himself at 1006 South Hill St., Los Angeles.

J. T. Smoot, former petroleum chemist of the U. S. Bureau of Mines, is spending a few days in San Francisco.

Loftus Hills has been appointed Government Geologist of Tasmania, in succession to the late **W. H. Twelvetees**.

C. D. Kaeding, general manager for the Dome Mines company, at Porcupine, Ontario, was here during the week.

Walter N. Burke has been appointed consulting engineer to the Abe Lincoln Copper Co. at Wickenburg, Arizona.

Leslie V. Waterhouse has resigned as mill-superintendent to the Mount Lyell company, and is now residing at Sydney, N. S. W.

E. J. Hoorwood, manager for the Broken Hill Proprietary Co., has been transferred to the Melbourne office of the company.

Forest Rutherford, consulting metallurgist, has returned to New York after making an extended trip through the South-West.

D. A. Lyon, supervisor of stations, U. S. Bureau of Mines, spent two weeks during February in San Francisco and Los Angeles.

G. M. Colvocoresses, general manager for the Consolidated Arizona Smelting Co., at Humboldt, was in San Francisco for a few days.

E. C. Andrews has been appointed Government Geologist to the Mines Department of New South Wales, in succession to **J. E. Carne**, retired.

Charles E. Mills, formerly general manager for the Inspiration Consolidated Copper Co., at Miami, was in San Francisco, on his return from New York.

Arthur L. Walker, Professor of Metallurgy in Columbia University, will deliver a course of lectures on the non-ferrous metals at Harvard University during this term.

R. E. Collom, petroleum technologist of the U. S. Bureau of Mines, has changed his headquarters from San Francisco to Dallas, Texas, where he will be in charge of the Bureau's office.

A. E. Strick, superintendent of the Mount Elliott copper mine, in Queensland, arrived on the 'Sonoma' from Australia on his way to a visit to the principal copper mines of this country.

Frank H. Sistermans, mining engineer of New York, has left for Mexico, where he will examine various mining properties in the interest of Eastern clients. His address will be care of Apartado 733, Mexico City.

Edwin S. Berry, of the firm of Yeatman & Berry, New York, arrived in San Francisco on March 7 from Australia, where he has been advising the Mount Elliott company in the Cloncurry district, of Queensland.

P. B. McDonald, assistant professor of English in the College of Engineering of New York University, has been engaged by the Western Electric Co. to give a series of 24 evening talks to engineers on the use of English.

THE METAL MARKET



METAL PRICES

San Francisco, March 9

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	12.00
Copper, electrolytic, cents per pound.....	10.00
Lead, pig, cents per pound.....	9.50—10.50
Platinum, pure, per ounce.....	\$150
Platinum, 10% iridium, per ounce.....	\$175
Quicksilver, per flask of 75 lb.....	\$80
Spelter, cents per pound.....	10.00
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

March 8—Copper is dull and weak. Lead is active and higher. Zinc is quiet and lower.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver \$99 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Mch. 2.....	132.00	83.75	Jan. 26.....	132.58	80.00
" 3.....	131.75	83.75	Feb. 2.....	134.37	83.83
" 4.....	131.75	84.00	" 9.....	132.50	87.89
" 5.....	129.75	77.87	" 16.....	132.10	85.72
" 6.....	128.75	78.87	" 23.....	130.00	83.55
" 7 Sunday.....			Mch. 1.....	129.87	82.75
" 8.....	128.25	78.75	" 8.....	130.37	81.16

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36
Feb.	85.79	101.12	131.27	Aug.	100.32	111.35
Mch.	88.11	101.12		Sept.	101.12	113.92
Apr.	95.35	101.12		Oct.	101.12	119.10
May	99.50	107.23		Nov.	101.12	127.57
June	99.50	110.50		Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Mch. 2.....	18.75
" 3.....	18.75
" 4.....	18.62
" 5.....	18.62
" 6.....	18.50
" 7 Sunday.....	
" 8.....	18.50

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	23.50	20.43	19.25	July	28.00	20.82
Feb.	23.50	17.34	19.05	Aug.	28.00	22.51
Mch.	23.50	15.05		Sept.	28.00	22.10
Apr.	23.50	15.23		Oct.	28.00	21.66
May	23.50	15.91		Nov.	28.00	20.45
June	23.50	17.53		Dec.	28.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Mch. 2.....	9.37
" 3.....	9.37
" 4.....	9.37
" 5.....	9.50
" 6.....	9.50
" 7 Sunday.....	
" 8.....	9.50

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	8.85	5.60	8.65	July	8.03	5.53
Feb.	7.07	5.13	8.68	Aug.	8.05	5.78
Mch.	7.26	5.24		Sept.	8.05	6.02
Apr.	6.99	5.05		Oct.	8.05	6.40
May	6.88	5.04		Nov.	8.05	6.76
June	7.59	5.32		Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11
Feb.	85.00	72.44		Aug.	91.33	62.20
Mch.	85.00	72.50		Sept.	80.40	55.79
Apr.	88.53	72.50		Oct.	78.82	54.82
May	100.01	72.50		Nov.	73.67	54.17
June	91.00	71.83		Dec.	71.52	54.94

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date			Average week ending
Mch.	2	9.10	Jan. 26 9.54
"	3	9.00	Feb. 2 9.41
"	4	8.95	" 9 9.07
"	5	9.03	" 16 9.06
"	6	8.95	" 23 9.25
"	7 Sunday		Mch. 1 9.20
"	8	8.85	" 8 8.98

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.67	6.53		Sept.	9.58	7.57
Apr.	7.04	6.49		Oct.	9.11	7.83
May	7.92	6.43		Nov.	8.75	8.12
June	7.92	6.91		Dec.	8.49	8.00

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.67	6.53		Sept.	9.58	7.57
Apr.	7.04	6.49		Oct.	9.11	7.83
May	7.92	6.43		Nov.	8.75	8.12
June	7.92	6.91		Dec.	8.49	8.00

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00
Mch.	112.00	72.80		Sept.	120.00	102.80
Apr.	115.00	73.12		Oct.	120.00	86.00
May	110.00	84.80		Nov.	120.00	78.00
June	112.00	94.40		Dec.	115.00	95.00

MONEY AND EXCHANGE

There is a difference in banking circles as to whether the Federal Reserve Board should suspend reserve requirements of the Federal Reserve banks against net deposits at this time. On the whole, the consensus of opinion is that the occasion does not call for such action by the Board.

In the first place, to do so might create unwarranted apprehension in the money market. Many people would not understand the reasons, and might magnify the emergency. On the other hand, such action would tend to nullify, to some extent, the measures now being put under way by the Federal Reserve authorities to bring about contraction. The Federal Reserve banks and their discount rates are the instruments by which the Reserve Board proposes to bring about deflation. If permission is given to reserve banks to go below their reserve requirements, they will not be able to exercise the same restraining influence upon credits.

The situation, in short, resolves itself into this: Either the Federal Reserve Board must suspend reserve requirements, as it is permitted to do, for certain periods; or else, if deficiency in reserves continues, the Reserve banks must raise discount rates still higher. Bankers are of the opinion that the Reserve Board would rather have recourse to the latter step, under the circumstances, than allow the Federal Reserve banks to continue any length of time below their deposit reserve requirements.

Able and successful bankers, however, believe that the Federal Reserve law should be amended in many particulars, notably in the case of deposit requirements. They say that while the 40% gold reserve should be retained against the notes, it is impracticable to have a hard and fast rule in regard to reserves against deposits. Reserves are made to be used, and this is just such an occasion when they should be.

As the loss of gold through exports, concurrently with expanding credits, is the cause for depreciation in reserves at the Federal Reserve bank, the question was put to a number of leading bankers whether an embargo should not be placed upon gold exports at present. In most cases bankers replied that gold exports should not be restricted, notwithstanding that the United States is now the only real free gold market in the world. Europe is sitting tight on its gold holdings, in spite of the heavy balance against her in favor of this country; while we are shipping gold in payment of such debts as we owe in the Orient and South America. Bankers say that this is now the test of our claim as a free gold market and our ability to play the role of international banker. It is recalled that we imported from Europe over \$1,000,000,000 in gold in the early stages of the War, and we should not be reluctant to part with some of this gold gain now.

One banker suggested, however, that the Federal Reserve Board might issue regulations whereby gold should be taken for export only on affidavit by the shipper that it was for the purpose of settling a bona fide debt. In other words, the practice of shipping gold by banking houses as a profitable exchange operation should be prohibited. This might be accomplished less effectively through a Government order than by a moral agreement among the banks. It is believed their support could be enlisted by the Reserve Board in order to conserve the United States gold supply for the general benefit of business.

Foreign quotations on March 9 are as follows:

Sterling, dollars:	Cable	3.66
	Demand	3.65
Francs, cents:	Cable	7.38
	Demand	7.37
Lire, cents:	Demand	5.62
Marks, cents		1.50

Eastern Metal Market

New York, March 3.

All the markets but that of lead are quiet and lower and demand is light.

Copper demand could hardly be lighter than just now and all sellers have reduced their asking quotations.

The tin market is exceedingly quiet with consumers practically uninterested. Values follow the highly speculative changes in London, which are very erratic.

Supplies of lead for nearby delivery are scant and values are advancing because of considerable demand.

Inquiry for and buying of zinc has lessened and quotations have declined also.

Demand for antimony is good but supplies are not plentiful. Prices are higher.

IRON AND STEEL

While buying for the railroads did not wait for their return to their owners on March 1, the steel trade has been busy in the past three days with new calculations of tonnage that will come to the mills in the next two months for railroad account. Estimates of early car contracts have gone as high as 100,000. The favorable decision in the Steel Corporation suit, though received with much satisfaction, has not been a market factor. The buying of finished steel by the railroads for car repairs and other purposes will be considerable. The Pennsylvania took about 10,000 tons of plates, shapes, and bars last week. Opposing views are coming out on probable developments in the next three months. It is known that some independent mills have no large bookings ahead, but much hinges on the rate at which transportation can be improved. There is questioning of the high prices established for certain products; at the same time, the rigid attitude of sellers remains.

Pig-iron production last month was at the highest rate since February 1919. The total for the 29 days was 2,978,879 tons, or 102,720 tons per day, as against 3,015,181 tons in January, or 97,264 tons per day. In 1919 the February output was 105,006 tons per day.

COPPER

Practically all large producers have revised their estimates of values and lowered their quotations to 18.75c., New York, for electrolytic for early delivery. Lake producers are practically on the same level as to prices. These quotations are largely nominal for there is practically no demand and the market could hardly be any duller. A buying movement is expected in the next two or three weeks or some time in March for the last movement of this nature in December supplied most consumers only for first quarter, although some of the buying included second quarter delivery. That a brisk foreign demand is inevitable ere long is firmly believed though at present it is negligible.

TIN

The market has been very quiet and devoid of much business. Consumers have bought but little and most of the trading has been among dealers. At present consumers are practically out of the market and trading between dealers has lessened. Spot Straits tin fell to 61c., New York, on February 27 but has risen again to 63.25c., New York, which was the quotation yesterday. These fluctuations have been almost entirely governed by the changes in the higher speculative London market, when spot Straits fell from £418 per ton a week ago yesterday to around £403 and then went back yesterday to £411 per ton. Because of the erratic and speculative nature of the London market business here has been almost impossible because importers and dealers are unable to do any reliable, stable, and consistent calculating.

Deliveries of tin into consumption in February are returned as 5200 tons, of which only 300 tons came in at Pacific ports. Stock and landing on February 29 were 3743 tons. The quantity afloat yesterday was 3195 tons.

LEAD

Unusual strength combined with quietness characterizes the market. Because producers in general have practically no metal for early delivery business is almost impossible. A canvas of the market by a dealer a day or so ago revealed only a little available for the latter part of March and a small amount for April delivery. There is no anxiety on the part of buyers to purchase abroad; they regard the market as too high and are only trying to buy what they need for prompt and early delivery. A fair appraisal of the market which is determined by outside sellers and producers, is 9c., St. Louis, or 9.25c., New York, for early delivery, with as high as 9.30 to 9.37½c. mentioned. Some say the latter quotation is the minimum. The American Smelting & Refining Co.'s quotation is unchanged at 9c., New York, or 8.75c., St. Louis. There is a very good export inquiry. That this will force prices still higher and cause a stampede is a possibility.

ZINC

The market is quiet and values have receded during the week. Prime Western for all positions up to July 1 is quoted at 8.75c., St. Louis, or 9.10c., New York, as compared with 9c., St. Louis, and 9.35c., New York a week ago. Demand from domestic consumers, which was fairly good a week ago, has tapered off and they are waiting and buying only what they need for nearby consumption. Some light sales were made on Monday as low as 8.70c., St. Louis, or 9.05c., New York. Foreign buying has also declined and so have prices in London which has had a sympathetic effect here. If anything the market was a little firmer at the close yesterday.

ALUMINUM

Prices of the leading interest are unchanged at 33c., New York, for wholesale lots for early delivery. Metal from outside interests is quoted for the same position at 31c., New York.

ORES

Tungsten: The market is quiet and quotations are nominally unchanged at \$6 to \$6.50 per unit for Chinese ores, \$12.50 for South American, and \$15 for high-grade Western domestic ores. There has been some buying but an active market is not expected until a decision comes in the tariff matter.

Ferro-tungsten is quoted at 80 to 85c. per lb. of contained metal, some sales being reported at 82½ cents.

Molybdenum: Quotations are unchanged at around 75c. per lb. of MoS₂ in regular concentrates. Very little business is recorded.

Manganese: Foreign ore is available in limited amounts at 80c. per unit.

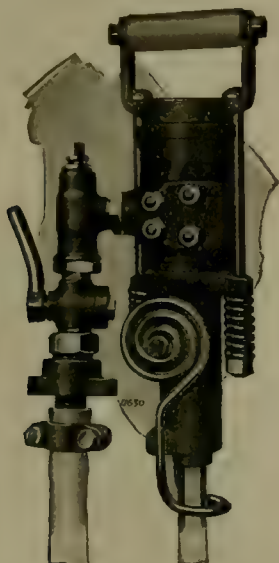
Manganese-Iron Alloys: Domestic ferro-manganese has again sold in small lots for spot delivery at \$200 to \$225 per ton, delivered. In one case \$250 was asked but not realized. Domestic makers are asking from \$160 to \$175, delivered, for last half or third quarter. Very little British alloy is available; the prices asked range from \$165, sea-board, up. The output of domestic ferro-manganese in February, according to the blast-furnace report of 'The Iron Age' was 16,283 tons against 18,062 tons in January. The spiegeleisen market is strong at \$57 to \$60, furnace. Domestic output of this alloy was 11,755 tons in February or practically double the January output which was 5895 tons.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A NEW 'JACKHAMER'

The Ingersoll-Rand Co. has developed, and is offering for sale, a new design of its well-known 'Jackhammer' group of hand hammer-drills. This machine, known as the BAR-33 'Jackhammer', is smaller and lighter than other Ingersoll-Rand machines of a similar construction. It fulfills a long



Bar-33 'Jackhammer'

existing need for a light self-rotating hammer-drill. Its weight, 21½ lb., should be a very welcome feature as it permits the use of a drill in locations and positions not accessible to heavier machines.

The manufacturer recommends this light drill for bench work in soft limestone quarries; for trimming in metal and coal mines, and for pop-hole work in quarries and open-pit mines. In addition to the above the machine may be conveniently used for drilling holes in concrete and masonry foundations. This type of 'Jackhammer' is not recommended for drilling deep holes or for use in hard rock, but for drilling where a machine of extreme light weight is desirable. The BAR-33 is the fourth type of 'Jackhammer' manufactured by the Ingersoll-Rand Co. Machines of this type are now available varying in weight: 21½, 35, 41, and 70 pounds.

RECENT DECISION OF U. S. COPYRIGHT OFFICE PERMITS AUTHENTICATING NEW CLASS OF EMBLEMS

It is now possible to secure Government registration and protection for an emblem or business badge by a concern which sells brain power or 'service' as distinct from a commodity having the physical attribute of merchandise.

Organizations of engineers rendering a selling or laboratory service have in the past made many futile attempts to

register their emblems as trademarks in the United States Patent Office. The Commissioner of Patents has been steadfast in supporting the Examiner of Trademarks who held that only insignia applied to articles of trade and commerce



A Patented Emblem

might secure the benefit of Government registration. No matter how valuable the 'service' it was held that such functioning was incapable of being officially tagged or marked by a sign of origin. Thus, a wide field of endeavor having for its product a salable service or responsibility has found itself without the same protection for its badge of reputation as is accorded a canner of beans or a manufacturer of monkey wrenches. The issuance, after a prolonged hearing, of a formal Federal credential authenticating the use of the emblem embodying the words 'Truth Well Told' by the H. K. McCann Co., advertising agents of San Francisco, is of significance to those who offer for sale the product of the brain as distinguished from commodities having physical form.

After being repeatedly balked at the Patent Office, the McCann company directed its efforts to the Copyright Office at the Library of Congress. The successful plea was based on the fact that the Constitution clearly states that authors and inventors are entitled to protection for their products, and, inasmuch as the protection was refused by the Patent Office, an obligation lay with the Copyright Office to protect a class of marks in many instances very valuable. The McCann company has just secured as the reward of its efforts the official certification of the emblem shown in the accompanying cut. The primitive hewer of stone, chiseling the words 'Truth Well Told', was the emblem granted recognition. Of chief interest is the fact that a way is now open to others for certifying the crest, trademarks, or insignia of laboratories and certain types of expert service. In granting protection the Copyright Office considered both the originality and artistic quality of the mark. Bizarre arrangement alone will not always secure protection.

WE MUST STABILIZE PRICES

The Paraffine Companies, Inc., has recently sent a letter of warning to its customers on the Pacific Coast under the caption 'The Time Has Arrived to Put on the Brakes'. The company feels that forward-looking business men and citizens cannot help but realize that a halt must be called—and called soon—in present tendencies, particularly in so far

as constantly rising prices are concerned, or calamity awaits us.

"Conditions affecting the roofing industry and allied lines are abnormal and puzzling in the extreme. On the one hand the demand from the trade is larger than ever before and greatly in excess of the ability of manufacturers to supply. On the other hand, raw materials are very scarce, in fact, almost unobtainable, with prices at unheard-of levels: Rags, for example, are now selling at \$85 per ton, an advance of \$30 per ton during the past six months.

"The situation in the East is even more acute than on the Pacific Coast, some manufacturers having advanced prices three different times during January. Others have withdrawn prices entirely. Others have called in their salesmen; while a number are booking orders only for shipment at their convenience and at prices in effect when shipment is made. As to the advisability—indeed, the necessity—of keeping prices down in general, there can be no argument. We, in common with thoughtful and patriotic citizens everywhere, recognize that prices cannot go higher without extreme danger.

"As a result of increased facilities, our manufacturing costs are considerably lower than those of most manufacturers. Because of this fact and our sincere desire to assist in stabilizing prices generally, it is our purpose not to take advantage of prevailing conditions to exact the limit in prices. In other words, we will give our customers the benefit of our increased facilities and the stocks of raw materials which we have on hand, and will advance prices only when our present large stocks are exhausted and we have to replace at still higher prices.

"In the meantime, we advise our customers not to speculate, but to buy to cover their immediate requirements only. If the building in sight in your community indicates a demand on you during the next three months for 100 squares, 500 squares, or a carload of roofing, buy that quantity and no more, but place your order now to ensure delivery of the goods when you need them. We urge also that our customers in turn do not attempt to secure from their customers the highest prices obtainable, but that they be satisfied with a fair and reasonable profit, because, in our opinion, it is only by so doing that our mutual interests and those of the country at large can be conserved."

REDWOOD FOR TANKS AND PIPES

The Pacific Tank & Pipe Co., manufacturer of cyanide-plant equipment, mining and mill supplies, uses redwood extensively. The qualities which make it particularly desirable for the uses to which the company put it are pointed out in Catalogue No. 12, recently issued.

"Long experience has proved to thousands of satisfied users, that Californian redwood is the best obtainable material for tanks and pipe. The trees from which the lumber is cut range in age from 500 to 1200 years. These redwood forests belong to an entirely different geological period from the growth upon any other portion of the continent. There is no similar wood found in any part of the world. Redwood contains a natural preservative which makes it impervious to the destructive action of acids and alkalies. It resists decay so well that trees which have lain five hundred years in the forests have been sent to the mill and sawed into lumber. For engineering purposes in contact with ground or moisture, redwood can be depended upon to maintain its full strength and service from 15 years upward. Seasoned redwood is one of the strongest woods for its weight. It is soft and yet strong enough to resist the most severe stresses. Its breaking strength, according to the U. S. government figures, is 62% that of white oak, which is probably the strongest and toughest of American woods. Redwood actually grows stronger with age. These remarkable trees contain no pitch or resinous matter and the wood is very diffi-

cult to ignite and very slow burning even when dry. Here is what a noted fire-chief, after more than 22 years in the San Francisco Fire Department, says: 'Under similar conditions of heat exposure, redwood lumber ignites much less quickly and burns much slower than resinous soft building wood, and I am also convinced that when redwood becomes ignited the fire is much more easily extinguished than other soft building woods'."

COMMERCIAL PARAGRAPHS

Charles Austin Hirschberg, Inc., advertising counselors, specializing in the technical field, announce that they are now situated in their permanent home in the Sun building, at 150 Nassau St., New York.

O. H. Johnson has been appointed special representative for the Intermountain region of the Taylor-Wharton Iron & Steel Co., of High Bridge, New Jersey. Mr. Johnson will have his office in the Denham building, at Denver.

The Pelton Water Wheel Co. has announced the appointment of W. D. Ward as manager of its Atlantic Department at 90 West street, New York. Mr. Ward has been associated with the company for more than 25 years, having been the ranking sales-engineer in the home office at San Francisco previous to his assumption of the post in New York.

The Justinian Caire Co., manufacturers and importers of assayers' and chemists' materials, of 573-575 Market street, have just issued a 292-page illustrated catalogue. The company announces that it has in stock a complete supply of pure chemicals made by the best of manufacturers, and that while prices cannot be guaranteed, customers may be assured at all times of the benefit of the very best market rates. The specialties offered include Calkins' assay-office appliances, zinc-shavings, resistance glassware, cyanide of potassium, pure acids from the Grasselli Chemical Company, Merck's pure chemicals, and Baker's analyzed chemicals. The stock of Calkins assay-office supplies is particularly complete and the quality is the very best.

The Chemical Catalog Co., 1 Madison avenue, New York, has just completed the arrangements for the publication of a handbook or a compendium of quantitative analytical chemistry. The author is a member of the faculty of one of the universities devoting special attention to chemistry, and has had extensive experience in applied chemistry and in chemical engineering. It is planned to include every method given in chemical literature, both in English and in foreign languages. The work will be in two volumes, one Inorganic and the other Organic. The Inorganic volume will be published first. Every journal and book likely to contain methods of quantitative analysis will be carefully searched. The material will be thoroughly indexed, not only under the elements and compounds, but also under the commercial articles in which the element is to be determined. Copious references to the original literature will be given.

The Denver Fire Clay Co. operates its own fire-clay mines near Denver, and through every process of grinding, blending, molding, seasoning, and burning, the work is in the hands of experienced workmen and under the supervision of experts. All raw materials are first subjected to extracting chemical analysis and physical tests by skilled ceramic engineers and burned at definite temperatures under pyrometer control to assure the most uniform products possible. High-grade fire clay is refractory and chemically inert; when properly mixed with suitable clays and binders it has relatively great mechanical strength. By skillful manipulation, definite textures can be obtained having various degrees of density and porosity, so as to meet the most exacting and varied requirements of the mining and metallurgical processes. A recent Bulletin from the company describes the products manufactured in interesting style.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Deery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N.Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MARCH 20, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

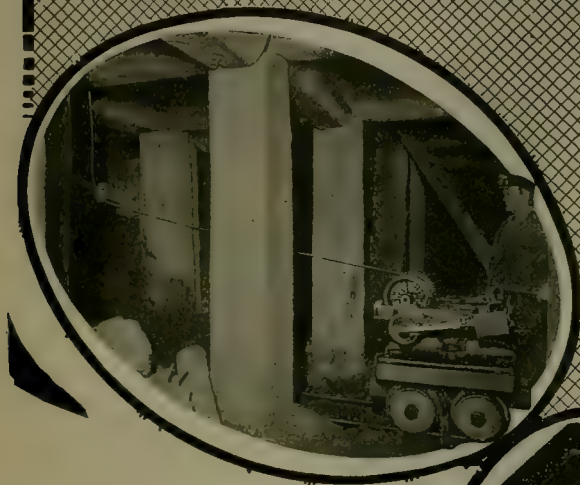
	Page		Page
EDITORIAL			
NOTES	401	By W. C. Frazier	407
MINING EXPLORATION	403	The problem is to interest the capitalist. It takes some money even to prospect.	
Comment on discussion elicited by J. H. Farrell's article on the subject. The passing of the prospector and the causes of it. Young men from the mining schools as possible successors. Their probable lack of patience for the work of exploration. Geological education, and the lack of it among the aids of the old-time prospector. Better morale of the mining business. Difficulty of obtaining a truthful description of a prospect. Tendency of engineers to shirk committing themselves to a favorable opinion. The inherent risk.		By G. L. Sheldon	408
		Overly cautious engineers. A scheme for systematic development on a broad scale.	
DISCUSSION		ARTICLES	
THE HOOVER CAMPAIGN	404	THE ELECTROLYTIC ZINC PLANT OF THE JUDGE MINING & SMELTING CO., AT PARK CITY, UTAH	
Organizations formed in San Francisco and Los Angeles to elect a delegation instructed to nominate Mr. Hoover at Chicago. Strength of the Republican party at this time. The letter to Mr. Arnold. Other statements from Mr. Hoover on the issues of the day; the equivalent of a platform.		By L. S. Austin	409
		Character of zinc concentrates treated. The roasting process. The calcine agitated in acid solution. Removal of copper and cadmium from the solution. Electrolytic precipitation of zinc.	
ELEMENTS OF SMELTING-PLANT DESIGN		THE ORE DEPOSITS OF MEXICO—I	
By Oliver E. Jager	405	By S. J. Lewis	412
The weight of crushed ore. Interstitial space.		Purpose of the writer. Geologic classification. The magmatic theory of ore deposition. Divergent views. Enrichment by circulating waters.	
ENGINEERING EMPLOYMENT BUREAUS		PHYSICAL EXAMINATION OF HOISTING ENGINEERS IN UTAH	
By Bradley Stoughton	405	By C. A. Allen and Dr. A. L. Murray	421
Service of Engineering Societies Employment Bureau v. American Association of Engineers.		Licensing in ordinary sense is useless. Physical examination as an alternative. Requirements.	
AN EXPLANATION		TWO FAMOUS LETTERS FROM MR. HOOVER	423
By C. E. Gilman	405	The first, on the occasion of President Wilson's appeal on the eve of the Congressional elections in 1918; the second, a statement of his attitude toward the Presidency on March 8, 1920.	
So-called 'report' on Montana oil-fields, in the 'Illustrated Review'. The facts.		ITALIAN QUICKSILVER INDUSTRY	424
REGISTRATION OF ENGINEERS		The deposits of cinnabar near Monte Amiata. Mining method. Treatment of ore.	
By Fernando Montijo	405	NOTES	
The apparent exclusion of foreign engineers. A protest. Justice?		MOGOLLON DISTRICT IN NEW MEXICO	420
MINING EXPLORATION		DEPARTMENTS	
By E. Hedburg	406	REVIEW OF MINING	425
The old-time prospector. The decline of prospecting. Reasons. Confidence in industry should be re-established.		THE MINING SUMMARY	431
By C. F. Francis	407	PERSONAL	432
The plight of the cinnabar prospector. Getting a tape around the ore.		THE METAL MARKET	433
		EASTERN METAL MARKET	434
		BOOK REVIEW	435
		RECENT PUBLICATIONS	436
		INDUSTRIAL PROGRESS	437

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.

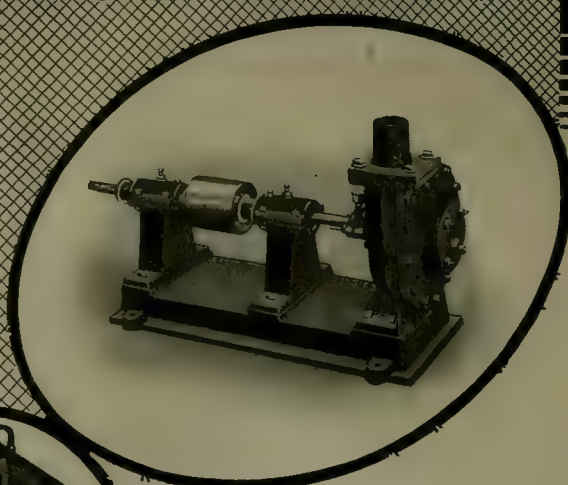
MINE EQUIPMENT FOR EVERY REQUIREMENT



HOLMAN Hoist

This stretcher bar hoist will handle from 500 to 1000 lbs. operating on but half the power required for a 3½-in. drill. You can take it into the most inaccessible places. You can use it for a thousand and one different purposes. And, when not in use, it can be placed out of the way.

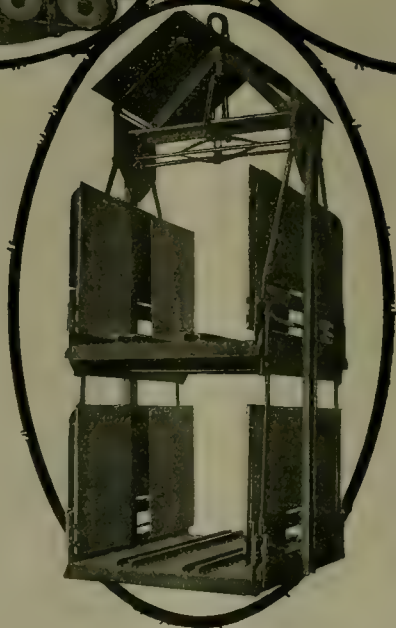
It is practically all steel and is so especially sturdy that it rarely requires any attention. It is in use the world over, like all Massco products.



SACKETT Sand Pump

This pump has met with marked success in the San Juan district of Colorado, where particularly hard quartz is encountered, replacing nearly all other types of pumps in that district.

It has an enclosed impeller; the shaft can be turned, thus giving double wear; adjustable to a larger pulley when desired; bearings and liner-joints efficiently protected from sand; all parts interchangeable. Get details concerning this pump.



MASSCO Cages and Skips

Made for every condition of mining. The Massco Double Deck Mine Cage is equipped with steel-plate doors and automatic chairs which are controlled by the station-man; and which automatically function when a level is reached. They are thoroughly fool-proof. Massco cages conform to the safety laws of all states. They are ready for immediate delivery in many types.

Massco Service the World Over makes it possible for you to get standard machine-tools, mining and metallurgical machinery, and assay or laboratory equipment at equitable prices no matter in what far-off corner of the world you may be. Three great warehouses are at your service. It will be worth your while to investigate fully

Just write, mentioning class of equipment in which you are most interested.

The Mine & Smelter Supply Company

DENVER

SALT LAKE CITY

EL PASO

New York Office: 42 Broadway



T. A. RICKARD, Editor

THE report from the Industrial Conference, of which Mr. Hoover is acting chairman, is expected shortly. It is understood that the Conference will re-affirm the principles of collective bargaining; present a plan for arbitration tribunals, national and regional; endorse the 8-hour day, except for certain industries in which it is impracticable; and give a qualified endorsement of the principle of a living-wage. On page 423 we publish the text of two important statements made by Mr. Hoover.

A MEMORIAL to members of the Institution of Mining and Metallurgy that fell in battle is to be placed in the house of the Institution in London. Lieutenant-Colonel Peter N. Nissen, well known in Canada and the West, has designed a figure, which is to be done in bronze upon a pedestal of malachite. The Council asks for gifts of malachite. Will not some of our friends, at Bisbee, for example, or in other copper-mining districts, send some selected pieces of malachite to the Secretary of the Institution at 1 Finsbury Circus, London, E.C.? The members of the Institution expect to raise a fund of £4000 for this memorial.

EVIDENCE introduced in a London police court against seven persons, one of whom is described as a gold miner, shows that 110,000 sovereigns were withdrawn from the Bank of England and melted into bullion, which was then sold at a premium. This is against British law, which prohibits the use of gold coins other than as currency. Another unexpected result has been the driving of the sovereign out of circulation in South Africa by the high price obtainable for gold in London. In view of the impossibility of securing shipments of the precious metal from Australia, it has been found necessary to buy gold on the London market, have it minted, and ship the coin to the Cape. But this process of 'sending coals to Newcastle' could not last long, because the cost of the operation became entirely prohibitive when gold began to climb to a premium of 50%. It is suggested that a mint be established in South Africa, so that the gold of domestic production may be stamped into sovereigns, but even then it is not clear how the retention of the gold coins can be assured without special legislation; and as to that, it must be remembered that South Africa is a self-governing dominion, not a crown colony. Another, more commendable, result of the enhanced value of gold has been the decision to increase by 20% the pay

of all officials of mining companies in South Africa. At the same time the abnormal price of silver has led to the passage of a bill in the British parliament for decreasing the silver contents of the token coinage from 925 parts of pure silver per thousand to 500 parts per 1000. This was done after rejecting proposals to issue small notes and nickel coins. If silver should depreciate, in consequence of increased production, there will be a temptation to forge coins identical in metal and alloy. On the other hand, at the present time there is a like temptation to melt the current silver coins. Evidently the disturbance of international exchanges and the barriers to economic adjustments are creating new problems.

UNDER 'Discussion' we publish a letter that makes an appeal that cannot be ignored. A Mexican engineer, the superintendent for an American mining company, writes to ask why he should be ineligible for registration as an engineer in the United States, if he came to this country, because he is neither a citizen of the United States nor of Canada. Are we to have a closed shop for the English-speaking members of the profession, and exclude all others? If we do, have we a right to expect a free field for American and Canadian mining engineers in Mexico and the great mineral regions that extend from the Rio Grande to Patagonia? Surely this is a narrow view and an ungenerous restriction. We extend our sympathy to Señor Fernando Montijo and venture to suggest to him that the clause to which he objects must have crept into Section 9 inadvertently, or on the initiative of someone parochially minded. It was not meant to cover the professional visits or the temporary sojourn of a gentleman like himself. We confess that we do not know what this clause was meant to do, and we hope that some member of the committee responsible for it will explain to Señor Montijo and to the rest of us. American engineers practise their profession all over the world; are we to deny reciprocity?

AMONG his multifarious duties Mr. Hoover has found time to look into the stabilization of the bituminous coal industry and to start a discussion before the American Institute of Mining Engineers. This is, we believe, his first contribution to the transactions of the Institute, although he has written many articles for the technical press and is the author of a standard text-book, 'The Principles of Mining', published in 1909. In presenting

his subject, Mr. Hoover states that the bituminous coal industry functions deplorably on account of its intermittency of production. It is equipped for at least 20% above its average output and thereby involves the employment of 100,000 more men than should be necessary and who are diverted from other productive occupations. The result is not only a needlessly high cost of coal but "a long train of human woe". It is an engineering problem. Mr. Van. H. Manning, the director of the U. S. Bureau of Mines, Mr. George Otis Smith, director of the U. S. Geological Survey, Mr. H. H. Stoeck, Professor of Mining Engineering in the University of Illinois, together with Messrs. S. L. Yerkes, Eugene McAuliffe, and Edwin Ludlow have contributed to a symposium on the subject that ought to lead to practical results. Of course, the most direct cure for the evils of intermittent production would be storage of the coal during periods of over-production—usually in summer—as against periods of maximum consumption—usually in winter. Most coals suffer by storage, becoming inferior to freshly mined coal. Storage under water has been tried to prevent deterioration, but the cost is high. For instance, at Whiting, Indiana, it cost \$3.30 per ton to construct an underwater pit for 10,000 tons of slack. The cost of unloading the coal was 10 cents per ton and the cost of reclaiming it from the storage-pit was another 10 cents per ton. Briquetting is another remedy. A third is to burn the coal in pulverized form. Another is to use it as a source of electrical energy at central power-plants to serve railroads. We expect that the committee selected by Mr. Hoover, as president of the Institute, will be able to present some useful suggestions. It is a matter that affects everybody.

THE qualifications of a competent hoisting engineer are peculiar. At a productive mine, where several hundred men are lowered and hoisted on each shift in addition to the moving of ore and material, the requirements, both mental and physical, are exacting. The position is one of unusual responsibility. The time was when the man who ran the hoist was primarily a mechanic, who repaired and kept his engine in order, and looked after the compressor, which was near-by; but at the same time the nervous strain of actually running the hoist was not great. Now, however, in consequence of the larger scale of mining operations, together with the influence of the labor-unions, the hoisting engineer, except in extreme emergency, does nothing but manipulate the controlling levers. The duties are less varied but not less difficult. In the opinion of one master mechanic, who has had charge of dozens of engineers on first-motion hoists, a man who has never seen a hoist, but who is properly equipped mentally and physically, can develop into an expert hoist-engineer in a week. On the other hand, this same man knows engineers that have run hoisting-engines for years, in whose hands he would not trust his plant under any circumstances. The physical requirements are good hearing and sight, and general good health. The engineer gets his signals by ear; his eyes register the movement of the cages or skips as shown on the indi-

cators; and he must be free from constitutional defects, as, for instance, a weak heart, that could result in sudden disability and consequent disaster. But the prime requirement is a steady nerve and a cool head. Statistics indicate that 15% of the fatalities in and around metal mines are the result of shaft accidents, and in the majority of these, the fault rests with the man operating the hoist. That there are not more speaks well for the competence of the men, as a class, who are engaged in this trying occupation, where a mistake of a few seconds or a few inches may mean disaster, and yet where speed is essential. The fact, however, that investigation of accidents has frequently disclosed serious discoverable weakness in the engineer emphasizes the responsibility of the mine executive in choosing hoist-men. On page 421 we give a report of some intelligent steps that have been taken by the State Industrial Commission of Utah to enforce the examination and licensing of hoisting engineers.

FROM the record appearing in the current bulletin of the Institute we note that 1727 ballots were cast in favor of the increased dues and 361 against. As the maximum of votes was 2274, which was the number cast for Mr. Hoover as president, it is noteworthy that nearly 80% of those who voted were in favor of the increase, but, as there are 8000 members, the percentage voting in favor of the change was only 21%. This only shows how small a proportion of the membership takes a proper interest in the affairs of the Institute. The advocates of vagaries in spelling were overcome in the ratio of 836 to 593, whereas only 441 voted in favor of all the proposed new spellings. Let us thank Heaven that this proposal was so definitely defeated, although in this matter likewise only a small proportion of active opinion was elicited. The new vice-presidents are Messrs. Seeley W. Mudd and Frederick Laist, both of them men of the highest standing in the profession. The speeches delivered at the banquet must have been delightful to hear. Mr. Lawrence Addicks increased his reputation as a toastmaster by his happy way of introducing the speakers; it is a difficult art, and he seems to know when to stop, which is the more difficult art. We regret that the members in California should have been identified with the spelling hysteria, but then we must remember that we in San Francisco have ever been regarded as 'kickers'. Mr. Winchell continued the note of humor, from which he passed gracefully into a deeply serious talk of a most timely character, the keynote of which was the need for co-operation of effort. Mr. Hoover's speech appeared in full in our issue of February 28. After he had spoken, Mr. Addicks bestowed the 'Order of the Golden Fleece' on Mr. James F. Kemp, the presentation being an excuse for expressing the cordial goodwill and high esteem in which the Professor is held by everybody in the Institute and in the mining profession. He is not easily outdone in witty repartee and proved it by his reply, in the course of which he referred to apex litigation, poking fun both at himself and Mr. Winchell, and making passing mention of "the editorial outpourings of the little volcano of technical journalism out on the Pacific Coast". Evi-

dently we innocent and quiet people out here are winning a reputation for being rambunctious, despite the mollifying influence of a climate so unlike that described in a celebrated treatise on the 'Geology of Jell', which was published, appropriately enough, in the "little volcano of journalism" just before the San Francisco earthquake. The author was able to use the petrography of Jell and even the pathology of the Jevil himself for honest fun, and we hope that the "little volcano" may never extrude anything that will scorch the sunlit meadows of his generous fancy.

Mining Exploration

We note with pleasure that Mr. J. H. Farrell's article on this subject has elicited discussion. Four letters appear in this issue. They come evidently from men in the field and from different parts of the country. All deplore the passing of the prospector and the exhaustion of the easy chances to find rich outcrops. Mr. E. Hedburg thinks that the young man from mining schools ought to go into partnership with the experienced prospectors, and exchange his familiarity with actual conditions for their knowledge of technology. He thinks that the young fellows lack the physical strength of the veterans; but the main difference between them is, we think, in the stock of patience. Young men are in a hurry, and prospecting takes time, lots of time, and persistence, and optimism. As to the last, youth is rich in optimism, but the real prospector is the greatest optimist in the world. As to "geological education", we demur to Mr. Hedburg's suggestion that the old prospectors had that advantage; on the contrary, while they had a sort of common sense, which is the beginning of science, they were recruited chiefly from among the uneducated; their geology and mineralogy were scanty. If they made an important discovery they were likely to be credited with more method than luck, and some of them obtained reputations of the *ex post facto* kind that were quite fictitious. As to wild-cattling and cheating—why not use plain English—in the mining business, we doubt very much whether that has hurt prospecting, because trickery has been a part of mining affairs since the days of Agricola, who in his book describes the same old tricks as are in vogue today. No; we think that mining speculation is less spoiled by dishonesty than in the days gone-by, because a better class of men has come into the business and the incidence of the law is more effective in checking wrong-doing. Thirty or forty years ago the crudest fakes and steals were perpetrated with impunity. The whole atmosphere of mining is less tainted than of yore. The reader will remark that we have some of the optimism of the true prospector. We may over-estimate the improvement in morals as the prospector exaggerates the value of his find. Mr. W. C. Frazier says that to this exaggeration is due much of his failure to connect with capital, and we think he is right. Those of us who have been engaged in the work of scouting for mines know well how often the descriptions given to us by honest fellows are ridiculously incorrect. Undoubtedly this excites a scepticism that is

hurtful to the business, because it breeds suspicion. If prospectors would, or could, give a plain unvarnished description of their finds, or the owners of prospective mines would, or could, tell a true story of the orebodies they have uncovered, it would save much of the time and money of the buyers of mines and of those 'exploration' companies that are so readily ridiculed for their failure to find satisfactory ventures. Probably we ask too much; we ignore the frailty of human nature, when we expect the owner of a mine to tell the exact truth or something near it. '*Caveat emptor*' is a warning with centuries of human experience to give it edge and significance. The sellers of horses or of motor-cars are no different from the man with a mine to exchange for cash. Mr. G. L. Sheldon has had a large and varied experience in what unfortunately is called 'the mining game' and we find ourselves in agreement with him on several points. Yes; there should be more digging and less conversation, but so long as one is more pleasant than the other there will be a disparity in their relative quantities. There is a tendency, quite natural, for the agents of exploration companies to prefer to sit in an office and examine the reports that come by post, rather than go into the mountains or the deserts in search for a rare thing, the mine that is worth more than it costs. For that is what they seek. There is also another factor, namely, some engineers are so anxious about their reputations that they avoid taking a risk. Of course, risk is inherent in mining, and the man who expects a sure thing had better do something else than appraise prospects for purchase; he might, for instance, become manager of a mine, for which work his cautious habit of mind would probably fit him better. Undue caution is probably the main deterrent to the success of exploration companies, but it must be acknowledged that men with the sure judgment or the instinctive appreciation of promising conditions are rare. It is not difficult for a properly trained engineer to make maps and take samples multitudinously and systematically, nor even to interpret the evidence as a means of estimating the ore that is assured, but it is exceedingly difficult to foresee the extension of the orebodies or forecast the future life of a mine. For that, much and varied experience is requisite, and also the kind of mind that obtains hints intuitively. Besides these qualifications there is needed another factor, namely, luck. "Faint heart never won fair lady," and young men afraid of their decisions are unlikely to make money for those who adventure in mining. It used to be thought that more money was to be made by buying prospects and developing them into mines than by buying ore that is measurable on three or four sides. If fully developed mines have come into greater demand it is because they lend themselves better to large financial schemes and the assured payment of dividends for a period long enough to permit the unloading of shares at a profit. The real sport of mining, and the most profitable phase of it, is to take reasonable chances on a number of prospects in the expectation that one or more of them will prove bonanzas. Mr. Farrell, in his article, made a number of sensible suggestions, one of them being the concentration of ex-

amination work on a promising district, instead of the mere flitting from place to place in pursuit of the will-o'-the-wisps brought to headquarters in the shape of unsubstantiated reports. In times like these when the prices of most metals are high, it should be advantageous to examine the records of old mines and the workings of idle mines, in the search for orebodies that formerly were too low-grade to exploit profitably, but that now, with the aid of better prices and more efficient metallurgic methods, might prove remunerative. The discussion of this subject is well worth while and we shall be glad to hear from some of the senior engineers, having published the views of the prospector and his friends. When all is said and done, it must be remembered that the search for mines can never be an exact science while the knowledge of the geologic conditions controlling the concentration of ore in particular places remains so inexact. Mining exploration will always remain speculative.

The Hoover Campaign

In our last issue we chronicled the organization of the Hoover Republican Club of San Francisco Engineers on March 5. Before that a similar move had been made at Los Angeles, two clubs of the same kind being formed to promote Mr. Hoover's candidacy. Likewise at Berkeley a Republican Club has been organized and has held two enthusiastic meetings. On March 11 a meeting was called at the Palace hotel, San Francisco, and a Hoover Club of California was started to co-ordinate the efforts of the various similar organizations now existing in California. It is complained by the old gang of the Republican party in this State that the supporters of this movement are largely Democrats; this is not quite true, but it is true that they include many Democrats. Sentiment has crystallized in favor of an effort to send to the Republican Convention at Chicago a delegation instructed to nominate Mr. Hoover and steps are being taken to elect such a delegation at the primary on May 4. Many voters registered as Democrats in the expectation that Mr. Hoover would be nominated by that party; they will have an opportunity to change their registration by going to the county clerk's office before April 3, which is the last day on which they can make the change. The candidacy of a Republican delegation in favor of Senator Johnson at the primary has been announced; the list of names reads like a financial menagerie. Mr. Hoover's friends believe that his own State ought to take the initiative in placing his name before the Nation and they intend to leave no stone unturned to accomplish that purpose. His letter to Mr. Ralph Arnold, as published in the newspapers of March 10, gave a cue and a stimulus to such action, because in that pronouncement he labeled himself "an independent progressive". Whether it was 'Progressive' or 'progressive', we do not know, but the intimation, taken with his telegrams to the Democrats in Georgia and California, indicates fairly clearly his party leanings, although again he stated that he "objected as much to the reactionary group in the Republican party as to the radical group in the Democratic party". The

plan therefore is to urge the liberal and progressive element in the Republican party to nominate him at Chicago on June 7. Neither party has come out with any announcement of principles. Mr. Hoover's own speeches give all the essentials for a party platform. He is the one public man mentioned for the Presidency who has not hesitated to place himself on record on the main issues of the day and on them he has spoken clearly and courageously. He is "ready to engage in team play with any organization and leadership that has for its objective the consummation and maintenance of great issues in the forms that he believes are to the public interest and benefit". He believes in party organization, "but it must be for the promotion of issues, not of men". He is for the League of Nations, with such reservations as are necessary to "clarify the world's mind that there can be no infringement of the safeguards provided by our Constitution and our nation-old traditions". He is against any party "dominated by groups who seek to set aside our constitutional guarantees for free speech or free representation and who hope to re-establish control of the Government for profit and privilege". He is against any party that is "dominated by groups who hope for any form of Socialism, whether it be nationalization of industry or other destruction of individual initiative". Here are specifications that should suit any member of the mining profession and every thoughtful citizen. Mr. Hoover does not believe in third parties, because he has seen the confusion and inefficiency produced in European parliaments on account of a multiplicity of parties, Right, Left, Middle, Extreme Right, and Extreme Left. Our American system of two parties works better. Furthermore, owing to the provisions of the Constitution for the correlation of the executive with the legislative branches of the Government, that is, the relation of the President to Congress, it is inadvisable, to put it mildly, to have a President who is unsupported by a majority in Congress. The muddle now existing at Washington is a telling example of the results ensuing from the conflict between a President and an unfriendly majority, particularly in the Senate. To elect Mr. Hoover as President without Congressional support would be futile; it would invite an *impasse* possibly worse than the one we now face. In order that he may be effective as Chief Executive it is necessary that he be elected at the head of a dominant party. The reaction of sentiment against the Democratic party on account of the blunders made by Mr. Wilson's administration, and on account of a normal desire for change after any party has been in office for two presidential terms, is shown unmistakably throughout the country. A large Republican majority is evident. Fortunately, Mr. Hoover is normally a Republican; he has never voted for a Democratic president; he served with President Wilson only because it was his duty to uphold the national government during the crisis of a great war. He is well fitted to lead the better and more progressive element in the Republican ranks and it is proposed to place him in a position where he can do so. The first President of the United States was an engineer; it is time to select another from the same profession.



Elements of Smelting-Plant Design

The Editor:

Sir—In the second part of my article appearing under the above heading in the issue of February 7, there appears on page 200 the following statement: "The size to which a commodity is broken will regulate its weight per cubic foot, since the finer it is crushed the less will be the interstitial space." I had marked this passage to be rewritten, but somehow omitted to do so until too late. As it now stands, it conveys the impression that fine ore weighs more than coarse ore, which would be true only if, in the process of crushing, a large amount of heavy mineral particles went into the fine.

The point that I wish to bring out is that the weight per cubic foot of broken ore depends on the way in which the ore breaks. If there is a certain amount of heterogeneity in the size of the broken product, the weight per cubic foot will be more, on account of there being less interstitial space. An example will make this clear. Suppose a bin filled with ore broken uniformly to pass a three-inch ring; there will be a certain amount of interstitial space and a certain weight per cubic foot; if with this same amount of ore there had been mixed an amount of smaller particles (say, half-inch size) sufficient to fill the voids between the three-inch pieces, the volume occupied would be the same, but the weight per cubic foot would be greater.

A definition of what constitutes 'broken ore' would be of assistance in interpreting the various tables on the subject.

OLIVER E. JAGER.

Nickelton, Ontario, February 16.

Engineering Employment Bureaus

The Editor:

Sir—On page 220 of your issue of February 14, 1920, is a letter from C. E. Drayer, Secretary of the American Association of Engineers, claiming that figures I have quoted are inaccurate. I therefore give you below the actual figures taken from a circular letter of the American Association of Engineers, dated November 1, 1919, soliciting new members and signed by A. H. Krom, Assistant Secretary, as follows:

"For three months period ending September 30th:

Applicants introduced	2985
Members placed	264

The corresponding figures for the same period for Engineering Societies Employment Bureau are:

Applicants introduced	5909
Persons placed	375 upward

As Engineering Societies Employment Bureau gives its services to members or non-members of any society, there are always a great many people who secure positions but do not report them. Our record of persons placed is, therefore, only a fraction of the actual number who secure positions through the Bureau.

BRADLEY STOUGHTON.

New York, February 28.

Secretary.

An Explanation

The Editor:

Sir—Your editorial of February 28 calls to my attention the fact that Mr. E. G. Lewis, publisher of the 'Illustrated Review' has published a "report" by myself on the Montana oil-fields. Never having made such a report, I naturally have been a little curious until today when I secured a copy of the 'Illustrated Review' and find that Mr. Lewis has published, with a few typographical errors, a letter written to him by myself on December 24 last. The closing words of which are, "Please accept this letter in no sense as a report. It is merely a few lines to keep you abreast of the situation." The weird sentence, "The formation bed is lime and the cap rock is soft shale", to which you properly take exception should read, "The formation *between* the lime and the cap rock is soft shale". When so read, it explains the reason for the 40-ft. cave at the bottom of the well. You will note also that the printer has made more or less of a mess of the paragraph preceding the above, but in spite of the resulting bad grammar the meaning can be determined with a little study.

Since you have used my name in your editorial I would appreciate your giving publicity to the above correction.

Roundup, Montana, March 3.

C. E. GILMAN.

Registration of Engineers

The Editor:

Sir—The committee appointed by the Engineering Council recommends in its report of a uniform registration law for engineers, Section 9, Clause 2: "Provided, however, that no person shall be eligible for registration who is under twenty-five years of age and who is *not a citizen of the United States or Canada.*" Is there a valid reason for including Canada and excluding the rest of the world? Is there a valid reason for prohibiting a Frenchman or a South American, etc., from practising engineering in the United States, if he is fully proficient in his profession and speaks and writes English as well

as the average American engineer? Surely there must be quite a number of foreign engineers, members of American engineering societies, now practising, that must emigrate upon passage of the law, if they choose to remain loyal to their native country. What if Spanish-American countries should pass a registration law prohibiting all Anglo-Americans from practising, unless they became Argentinian, Chilean, or Mexican citizens, as the case may be? There is no likelihood of any such law on account of the scarcity of engineers in Spanish America, but, should advantage be taken of the fact, in justice? Hoover, and how many more eminent American engineers, would have been excluded by a similar law from practice in foreign countries. And, after all, what is there against allowing a law-abiding and respectful foreigner to practice his profession when residing in any State of the Union? Is the object to do away entirely, gradually, with all alien residents?

FERNANDO MONTIJO.

Mexican superintendent of Las Chispas property of the Minas Pedrazzini G. & S. Mining Co., an American company.

Arispe, Mexico, February 27.

Mining Exploration

The Editor:

Sir—Conditions in the mining districts, all over the country, have changed so much in the last thirty years that people cannot help notice the vast difference. Mr. J. H. Farrell's article in the 'M. & S. P.' sounds the keynote, which undoubtedly indicates the present trend.

On the other hand, from all sides we hear of the demand for mines and prospects. The surplus of Eastern money caused by the large war-profits of the past years has been seeking an outlet. Probably more money is available for investment in mines than at any time during recent years, but the mines are not being found. "Why is it?" we ask. Because the conditions have changed, the old productive mines are worked out, and not many new ones are being found. The old prospector and his burro are gone, there are very few left in the hills. The prospector of the 'seventies and 'eighties undoubtedly found the mines, as is shown by the records. They were men with experience, brains, and brawn, and not a few had a geological education, but endurance was their main stock in trade. So the first thing they did was to call on local merchants for a grubstake, on a basis of 50-50, secure the pack-burros, and strike out for the mountain and desert. When they arrived at a likely place, they would camp and start to prospect, always going hillward to follow and trace any float to its vein, from where it may have broken off and worked down the hillside. The vein found, the next procedure was to examine it carefully, break-off samples, rub the rock and horn it, for free gold or other metals. I have known prospectors to be experts at this, and to be able to tell values from five dollars per ton up, from vein-matter, or from one dollar up on panning gravel.

Having found the prospect satisfactory the next thing the prospector did was to sink a 10-ft. hole and put up the location monuments, select a camp-site, and develop water for camp use, finally settling down to the developing of the mine by sinking shafts and driving tunnels. Occasionally he traveled back to some town for supplies as needed, and often he had to hunt straying burros for days, or carry a limited supply on his own back for want of other means of transport. I have known prospectors to do over one thousand feet of work on a single claim, and in one specific instance to sink a shaft one hundred feet in depth and do it all alone, by climbing out to hoist each bucket of rock or ore. Those men found the mines of old and they were all real he-men, who are now passing away.

The reasons for the lack of prospecting are three. The large exploration and mining companies require developed mines, with the ore-supply blocked out, for which they are willing to pay according to the amount of ore assured. The prospector is hardly able to develop a mine to that stage of showing. To illustrate, in 1913 one of the large mining companies reported that 639 properties were submitted to its engineering staff and that 538 were rejected on examination of data and reports. Eighty-two of the others failed to pass the field examination, and out of the remaining 19, two properties were taken over on long-time option with an arrangement to pay for the mine out of the profits made.

Is there any wonder that prospecting is declining? It is now impossible to go to a merchant in any town and ask for a 50-50 grubstake. They will laugh at you; they have lost all faith in the mining game.

Another reason is that the public still remembers the wild-cat speculation of the 'nineties caused by unscrupulous promoters, which were exploded by the national magazines. It was a game for robbing people in the East by their own friends or acquaintances, using the mining industry as an excuse to sell stock. The result was that it tended to put legitimate mining in bad repute and was the cause of several States passing blue-sky laws for protection. That has hurt the prospecting more than anything else; the public look with suspicion on any new venture in the mining line.

And last, but not the least, now that the superficial rich deposits have become rare, the prospector may only expect to find deposits so low grade as to be unprofitable to his own limited means of exploitation. Truly in many ways the independence of the prospector is gone, for he finds something that is of no use to him for payment as he goes, and the public is not willing to put up for the expense of developing low-grade deposits, which in most cases would make profitable mines when once opened. The only course left for the prospector is to work in some near-by mine for day's pay and accumulate enough capital for developing his prospect. This is frequently done, when no other means is at hand. The prospector is absolutely necessary to successful mining, for it must be the prospector who originally finds the property for the engineer who scouts for the capitalist. No corporation can require from its employee the endurance of such hard-

ships as are cheerfully undertaken by the prospector when the gain to be made is his own or to be shared with a few individuals or partners. On the other hand, the young engineers turned out of schools in many parts of the country are not fitted to undertake prospecting, as they lack the practical side of the work; neither have they the required endurance or brawn. Bear in mind that you cannot find and develop mines in an Eastern office-building, neither in sleeping-cars nor high-powered automobiles; so my advice to young engineers when out of school is to come out West if you possess some means or backing, and want to make a success in the mining game, to go into partnership with some good practical prospector of the old school, and prepare to rough it. It will promote your health, give you needed experience, and possibly satisfactory remuneration, at the same time you are helping in a good cause, to assist the prospector and the finding of new mines. You will by this means re-establish confidence in the mining industry with the folks at home by being right on the job yourselves. And do not look to the mining companies for a job, as is usual with engineers when just out of school, because they are over-run with applications from students. In one case a young engineer, a friend of mine, sent out 200 inquiries to mining companies. All answered that there was no chance for a place immediately but to inquire again some time in the future—a poor consolation at best. So, therefore, with the education and some means or friends, there are unlimited possibilities in the field of prospecting for the precious metals.

E. HEDBURG.

Kingman, Arizona, March 1.

The Editor:

Sir—I have just read the article by J. H. Farrell. He only touches a few of the high places; he is good on mining-camps and near-by properties. The poor old prospector that goes miles from any known mineral deposit and opens up a good grade of ore is out of luck; when he starts out to get money out of his discovery, he is told on every side that the locality is not known as a mining country and Mr. Tapeline has no interest in the poor devil, especially if he hasn't something that he can get his tape all the way round. I have been twenty years where I am now writing this and have looked California over well for money on a cinnabar property on a royalty basis or otherwise. Cinnabar is about the poorest mineral to raise money on among the minerals of any real value, and is usually ready cash on 30 days, or less. One drawback is that there are seldom large head-lines in the papers, like an oil excitement or a big gold strike, to create a rush and start the man with money to thinking. There is over 1000 acres in this part of California to be had for a song compared to what is paid for property out of this State. In some places it is easy to bond mines for large sums of money. They even pay more on a bonus for oil than they would be willing to pay as a purchase price for mineral lang in California. This State has produced more quicksilver than gold; there is a well-known stratum on which all the big mines are or have been.

I cannot understand why there isn't money to be had to open up a fair showing on this big-producing stratum. Just think what the Almaden quicksilver mine has done. This country has produced thousands of dollars worth of quicksilver from workings on a small scale and in an expensive way. There has been about \$100,000 worth of ore taken out here in a place about the size of a small two-story house, while a pocketful of picked ore from other places sets the country wild and money comes by the millions to buy all there is to be had with large payments down on supposed mineral land. I have failed to find engineers that know cinnabar property when they see it. Of course, they know the ore, but nothing of how the formation should lay for a good producer. They are only ready with their tape when they are shown ore and care no further about the property. I would like to give the man with the \$5,000,000 a good talk on cinnabar. California is down to 15,000 flasks of quicksilver for the year 1919. This county can produce that for the next 25 years. We have the formation on the big-producing stratum and no money to open it up when they can get it for less than half its value; you do not know that men of money try to starve the prospector out so as to get the property at five cents on the dollar.

C. F. FRANCIS.

Parkfield, California, March 1.

The Editor:

Sir—The article by Mr. Farrell sure strikes the keynote, when he says to "dig more".

The deposits of mineral are not all opened up yet by a long way. But how to get money to do it is indeed a problem. Most prospectors make the mistake of very much over-estimating their finds. These times no one will purchase a prospect without sampling it, and when the assays are in from the sampling, and returns scarcely show 10% of the claimed value, the deal, of course, is off at once.

A prospector cannot be blamed for hoping he has a good thing. But so many of them are away beyond hope that when someone does come along that would do something with it, if the showing justified, there is so much difference between hope and reality that the deal is off before it has scarcely begun. Someone has said that there are liars, there are damned liars, there are prospectors, there are promoters, there are fiscal agents, and there are smelters.

There are prospects of promise that it would be impossible to make a report on that would even interest an engineer sitting at his desk. I know of one property that is tapped with a tunnel at the 100-ft. level, in perhaps 125 ft., stoped to the surface. The vein averaged 16 in. wide, and milled an average of \$100 per ton. But there is practically nothing left above the tunnel-level. Below this tunnel, 163 ft., there is another tunnel, in 430 ft., in country-rock, parallel with the vein. On which side of it the vein is no two can agree. Below the upper tunnel there is a winze sunk 26 ft., 4 by 4 in. size. From this there was taken 10 tons of ore that milled \$160 per ton.

The time was when men would put money in such a

prospect. The price is right and the terms are right, but a report cannot be made on it that will attract an exploration company enough to send a man to look at it. Digging is what it needs.

There is another on which there are two shallow shafts, about 400 ft. apart, on the same vein. The shafts are perhaps 12 to 14 ft. deep, and the vein exposed is something like 2 ft. wide. Five wagon-loads of the ore taken out was hauled off and milled. It produced \$2200. 400 ft. in depth could be had on this easily, but it lies there from year to year, waiting for someone that doesn't seem to come along, that will do some digging in it.

What we are all looking for is someone that will tell us how to get the men with money to open up a property, like the above, that would be classed as a mere prospect, but where digging might develop a paying mine.

Nampa, Idaho, March 2.

W. C. FRAZIER.

The Editor:

Sir—Referring to the article by J. H. Farrell, this is the best thing published on this subject in years; it is good 'horse sense'. If mines are to be found, it must be by work; 'dig' is the word. They cannot be found today by sitting in the office reading reports.

The policy followed in late years by the large operating companies gets few results. The fact is that nine out of ten mining engineers turn down a mine or prospect if there is the least doubt of its being a success. They figure that this is safe, because it is easy to say, if it makes good later, that there was not sufficient work done to be able to decide, when it was examined. Again, it often happens that their field experience has not been sufficient to enable them to judge, compare, and form an intelligent opinion. Very few have the courage to express their opinion on a prospect, if inclined to favor it.

There are no developed mines for sale today, at a fair value.

In 1910, in Mexico just prior to the revolution, we had a scheme about completed that ought to win. Some New York people agreed to put up \$250,000 and a company was organized. A man was picked out who was familiar with a certain portion of a State in Mexico, who had had a large field experience, regardless of whether he was a technically trained man or not; but he must have had a varied practical experience, and become familiar with his district. He was to pick out or select a prospect or partly developed mine, the best he knew, securing it on a bond and lease upon as favorable terms as possible. The head engineer, a man of large field experience, of mature years, and of good judgment, would examine and pass upon it. He would recommend the expenditure of \$1000, or \$5000, or whatever amount appeared advisable, as work progressed, for development as both engineers agreed. At any time that such development showed the conditions to be unfavorable to the making of a mine, we would quit. But, if after the expenditure of \$5000, they both agreed that the chances were still favorable, then the work would be continued. The point being, that whenever they (with any other members of the association

in consultation) agreed that the conditions were so unfavorable as to leave no chance of success, we would quit it and try another prospect. There were to be ten of us in the field in various parts of northern Mexico. In those days the peso was worth 50 cents in U. S. currency; labor was cheap; it was considered that the original capital, equal to \$500,000 Mexican, should be divided among ten districts, and that on the average \$5000 Mexican would probably determine whether to abandon a property or not; thus giving us 100 chances. We thought that with good judgment in selection and proper management, the chances of our securing one or more real mines were excellent.

In that event we would win; we would be ahead of the game, having secured a good mine at a less price than it could be bought. Each of the ten field-men had a stock interest, expenses, and a nominal salary. The idea was that we were all working for our own interests, so we would keep down the overhead expenses (only the consulting engineer). As soon as a mine was found warranting a large expenditure, those who put up the original capital agreed to finance it under a separate corporation; all of us obtaining a block of stock in the new company. A proposition along similar lines ought to win in the United States today. Let the consulting engineer select the areas for work on the basis of previous history, production, and geological conditions. Then pick out a hard-headed man of practical experience in that particular section (if a technical man, all the better, but he must know his district well). Enlarge the scheme by operating in several different States or sections. Put the money in the ground, economically, at least until such a time as the mine is on a dividend basis.

I believe that the results obtained would be far cheaper than the mines found and purchased by the large companies. It is the exception to see a report that warrants the cost of an examination; but we often see one in which the geological conditions are good; but perhaps not sufficient work has been done, or it is old and now caved in, or it is impossible to get a clear understanding of the conditions. Few owners appreciate the necessity for having a good report upon their property. Mutual interest, co-partnership along the above lines, cutting out large overhead expenses, should win.

The main thing is that 'digging' is done.

Denver, March 4.

G. L. SHELDON.

THE most important uses of zinc are as a constituent of the alloy, brass; in galvanizing; as structural sheet; and in the desilverization of lead bullion. The consumption is greatest in galvanizing. A wide list of miscellaneous uses for zinc includes the chemical, rubber, paint, electrical, and metal industries, and medicine. The chief use of zinc ores is, of course, for the manufacture of spelter, but an increasingly large amount is used in the United States for the direct manufacture of zinc oxide and other pigments and zinc-dust. Blende is an important source of sulphuric acid, a large tonnage of which is recovered as a by-product in the making of spelter.

The Electrolytic Zinc Plant of the Judge Mining & Smelting Co., at Park City, Utah

By L. S. AUSTIN

This company, under the management of G. W. Lambourne, over two years ago, built this plant for treating one of their concentrator products, at this time sold with difficulty and at a high cost for treatment to zinc-smelting works in the Middle-West. It boldly undertook this at heavy expense to make itself independent of smelter-rates and that it might realize full value upon the tailing left after extraction of the zinc, which, freed from zinc and low in silica, then became a desirable product for smelting.

The plant is situated in a small canyon about a mile east from town where a suitable flat was available as a site. It is reached by a spur railroad from the main line at Park City, so coal can be brought in, and so that the tailing or residue, one of the sources of profit, can be shipped away to one of the silver-lead smelters in the Salt Lake valley.

The material treated is zinc-concentrate, one of the products of the Judge concentrating mill. It contains 35% zinc, 8% iron, 5% silica, 31% sulphur, 3.5% lead, with about 15 oz. silver per ton. Besides these there are small quantities of copper and cadmium, impurities that have to be separated from the final zinc solution before it is electrolytically precipitated. There are two kinds of concentrate: from the jigs and from the tables. The table concentrate is sent direct to the roaster, while the jig product, too coarse for proper roasting, must first be ground. About 30 tons of the two, principally the tailing-concentrate, is treated daily. It is hauled by team two miles to the electrolytic plant.

About the first day of May there was a strike for increased wages at the plant, which was shut-down in part because of the strike, in part because of the unsatisfactory condition of the zinc market. The strike difficulty, I hear, has been composed, so that, when roaster repairs have been made, the plant will again be started. It is claimed by the management that the plant has only just paid its way, but the recent rise in the price of zinc and of silver should encourage future operation.

The jig-concentrate, amounting to about 20% of all received, is dumped into the boot of an elevator, which takes it to the feed-hopper of a cylindrical revolving dryer for the removal of its contained moisture. This fits it for dry-grinding in a Hardinge ball-mill, where it is reduced to suitable size for roasting.

As it comes away from the ball-mill it is raised on a belt-elevator to spill upon a horizontal belt-conveyor, discharging upon the drying-hearth or top of the Wedge roaster.

The main portion of the roaster-feed is the table-con-

centrate, which is elevated by a skip-hoist to the roaster feed-hopper.*

The ore received an oxidizing roast at a temperature of 700°C. in a seven-hearth Wedge roaster of 25-ft. diameter. There are two opposite fire-boxes, coal-fired, at the sixth hearth, the seventh hearth being devoted to the cooling of the ore. The products of combustion escape by the side-flue at the upper or first hearth, although they may also be drawn off at the second hearth if desired, both exits being dampered. The greatest heat is at the second, third, and sixth hearths, and the rabble-arms on these hearths are water-cooled, while the others are air-cooled. The hollow central shaft has a step-bearing, riding on two hardened steel discs, all in oil. It appears that the older way, that of carrying it by means of idler-rollers, has been abandoned, owing to the irregular wear. The driving is done by a motor, through a double-cone variable drive and a train of gears to the bevel-pinion that meshes into the master-gear below.

At this elevation, of 7200 ft. above sea-level, the vigor of burning is less than at the electrolytic plant at Anaconda (5500 ft.), where, under steady firing, there would be danger of the formation of zinc ferrite. I am disposed to compare this with the great difficulty of roasting at Leadville at the elevation of 10,500 ft., and with smelting in the high Andes, where, as the air becomes thinner, the same trouble occurs. One is tempted to compare this condition with what occurs in the operation of air-craft. Thus, the De Haviland plane has a speed at the ground of 125 miles per hour; at 6500 ft., of 120 miles; at 15,000 ft., of only 113 miles per hour.

The hot, easily-running calcine is discharged by a steeply inclined 4-in. pipe to the Baker cooler, a cylinder resembling a tube-mill. This revolves partly immersed in a tank containing water, whose level is nearly up to the 12-in. feed and discharge openings, and where cooling is effectually done. Within the cylinder, a row of deflecting blades, or rabbles, moves the calcine along to the discharge.

Here is a product with most of the zinc in the form of zinc oxide, a little of it as sulphate and sulphide, and the other bases thoroughly oxidized. It is charged into one of two Pachuca vats, operating separately, where it is

*One might expect a hanging up or bridging of a moist product, especially in a hopper with a bottom slope of about 40°. However, that seems to cause but little trouble in the feed-chute. It may be recalled that in the Wedge roaster, to feed the material, a finger, attached to one of the rabble-arms, sweeps through the talus of ore at the mouth of the feed-chute, pushing it upon the hearth.

agitated by compressed air with addition in the vat of a sufficient quantity of acid solution from the stock-solution vat. The zinc oxide is dissolved as well as part of the copper and cadmium.

The well-agitated product, a mixture of sand and slime, passes on to a drag-classifier, where the sand is removed, while the overflowing slime goes to a Dorr thickener. This yields two products, a thickened underflow or spigot-discharge for the Oliver filter and a clear overflow. The sand from the drag falls into a bin to be shipped away for smelting.

At the Oliver vacuum-filter the thickened slime, in the proportion of two of water to one of slime, is filtered to yield a product, apparently solid, but still holding 40% moisture. It is this that is shipped to the smelting works, containing in the dry slime 20 oz. silver and 0.02 oz. gold per ton with about 6% lead and 5% insoluble. The smelter objects to the high moisture in this product; but, mixed with granular concentrate or fine ore, it should make excellent briquettes.

We come now to the interesting point, the removal of the dissolved copper and cadmium, not only in the overflow from the Dorr thickener, but in the filtrate from the Oliver filters. Until the copper and cadmium are removed, the solution is not ready to go to the electrolytic vats, since there these metals would be then deposited with the zinc. Therefore, the united solutions go to another agitation tank, and with the addition of zinc-dust (particles of zinc in metallic form) are intimately mixed until the impurities are precipitated. The reaction completed, the mixture, dust and all, is passed on to one of the two Sweetland filter-presses having 36 leaves of the disc type, 3 ft. in diameter. The quantity of zinc-dust and precipitate is but little, so that the filter is opened only every other day, sprayed clean, and again closed for action. The clarified solution is pumped into one of the three solution-storage vats, each 20 ft. diam. by 18 ft. deep, ready for use in the tank-room.

To recover the cadmium, the precipitate, after removal of the zinc-dust, is dissolved in dilute sulphuric acid, and the cadmium is electrolytically precipitated. The result is a pure white metal of 8.6 specific gravity, zinc being but 6.8.

The tank-room, 50 by 160 ft., has 120 vats in 12 rows. The anodes and cathodes in a vat are in parallel, the vats themselves in series. There are 18 anodes and 19 cathodes per vat, each exposing a surface 2 by 3 ft. to the electrolyte. The current resistance between anode and cathode is 4 volts, making the total 240 volts at the generator. The vats are graded, so that each set of five vats has its cascade to the last one. In addition, a further supply is obtained by an overhead pipe that may be passed into the flow at any desired vat, or into all of them. The anodes are lead sheets, the cathodes aluminum ones, each 24 by 36 in., hung at two-inch centres.† In the

tanks the zinc deposit is built up to over $\frac{1}{16}$ in. thick in two days. The cathodes are then removed from the bath and this coating is stripped from the cathode.

There are two motor-generator sets. The current coming in on a line at 40,000 volts in order to drive the motors is stepped down to 2300 by stationary transformers. The two generators develop 10,000 amperes at 250 volts or 5000 amperes at each set, that is, 25 amperes per square foot of cathode area.

Anyone acquainted with the melting of metallic zinc knows the difficulties that arise from the extended surfaces presented to the oxidizing influence of the air in melting, and how difficult it is to avoid drossing. At this plant there is used a small reverberatory furnace with hearth-dimensions of 5 by 8 ft. and about 12 in. deep to the sill of the side-charging door. The sheets are charged, and are melted down in the closed furnace with a reducing flame, then dipped into molds holding 50 lb. each.

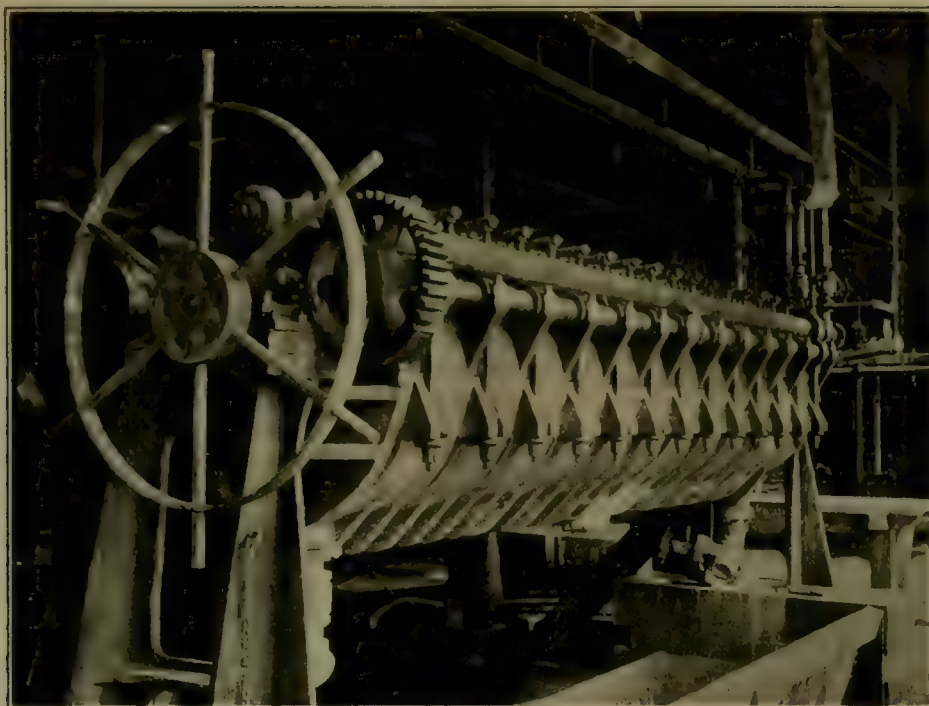
THE PRODUCTION of metallic sodium and the various compounds or salts of sodium in the United States in 1918 was 10,198,842 tons, valued at \$142,682,575, according to R. C. Wells, of the U. S. Geological Survey. This was an increase of only 34,000 tons in quantity but of \$10,000,000 in value over the corresponding figures for 1917. Detailed figures showing the production of each individual compound, together with short descriptions of the methods of manufacture, uses, exports and imports, and other related information, are contained in a publication issued by the U. S. Geological Survey as a chapter of the Geological Survey's volume on 'Mineral Resources of the United States, 1918'. A copy may be obtained from the U. S. Geological Survey, Washington.

THE Irvinebank Co.'s tin-dressing plant and smelter at Irvinebank, North Queensland, which is 110 miles from the seaport of Cairns, has been purchased by the Queensland State government for approximately \$100,000. The plant comprises a 50-stamp mill in 10-stamp batteries, blacksmith shops, forge and machine shops, and repair sheds. The works are lighted throughout by electricity. Belonging to the property are three locomotives with the necessary rolling stock, and a tramline 14 miles long to the nearest railway station. Irvinebank is situated in the centre of a district in which lode-tin is found in large quantities.

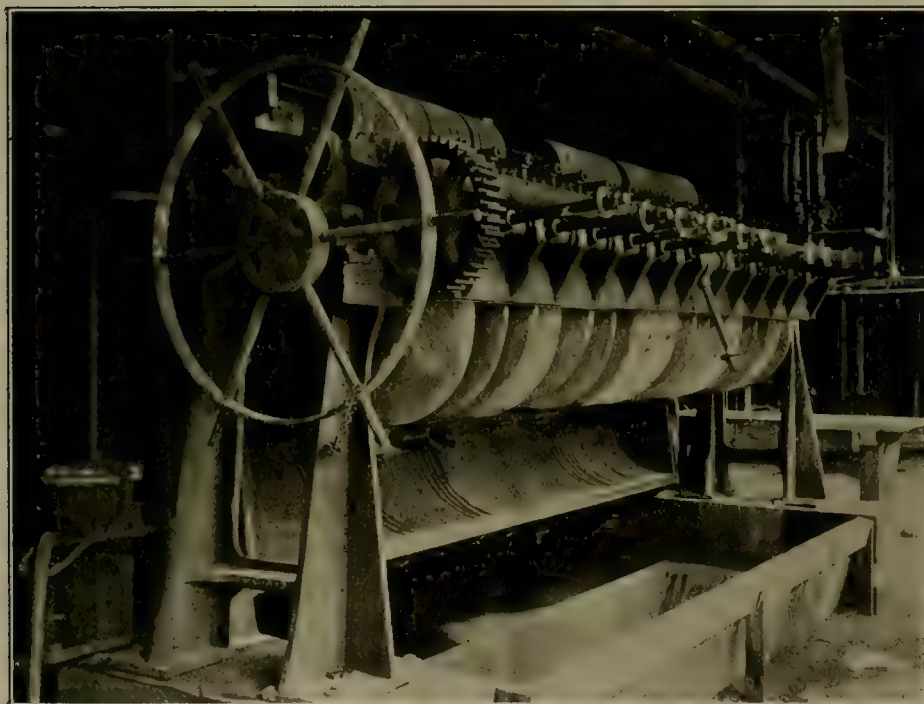
THE most important source of silver in the United States is Butte where it is produced chiefly as a by-product from the electrolytic refining of copper, and from the residues produced in the smelting of zinc concentrate.

ventional way. Thus, the revolving disc, 3 ft. diam., would have but 40% of its area exposed to the solution, or 7 ft. square, compared with 2 by 3 ft., or 12 sq. ft., for the hanging anodes. On the other hand, the revolving anode, because it was constantly moving through the electrolyte and so exposing fresh impolarized surfaces, had certain advantages.

†When the plant started the cathodes were revolving discs moving between the anodes. This was later abandoned because of trouble arising from short-circuiting and from the small area exposed; then the anodes were hung in the con-



NO. 12 SWEETLAND FILTER WITH WIDE-LEAF SPACING, AS USED IN THE JUDGE MILL



THE SAME, SHOWING CHUTE BELOW FILTER FOR RECEIVING THE CAKE WHEN DISCHARGED

The Ore Deposits of Mexico—I

By S. J. LEWIS

INTRODUCTION. The ore deposits of Mexico, to those of us who are engaged in metal mining, are the most fascinating features of the country. It is the aim of the present papers to set forth briefly some of their important characteristics, as they appear in the light of recent research in economic geology.

Problems of origin, enrichment, and alteration of ore deposits are being studied today with increased interest owing to the recognition of the part played by chemical agents in the making of ores. Much laboratory work is being done, with the microscope as well as with reagents, and conclusions of great importance are being approached or indicated. These conclusions are seldom easy of compact non-technical expression, especially as they relate to isolated steps in a series of experiments. The leading students of the science, in presenting their work in the technical press, generally address the limited audience of their fellow-investigators instead of the mining profession in general. The conclusions reached in such work are subject to many limitations and reservations, and it is difficult to make a plain statement of opinion without finding oneself plunged into controversy. Nevertheless, it should be possible to express in clear language such of the progress as has crystallized into clear thought.

As a practitioner in the special field of metal mining in Mexico, it has occurred to me that most men engaged in mining would be interested in a brief exposition of current scientific thought concerning the origin of ore-bodies, so correlated with the geologic history of the country as to form a continuous narrative, and taking nothing for granted as to the knowledge of the reader. Illustrative examples will be given of the different types of mines in the country, and coal and oil will be omitted from the discussion, as belonging to a special field of their own.

CLASSIFICATION. Our knowledge of the geology of Mexico is based upon reasoning from scattered and imperfect records. These records, in the form of strata and fossils, are seldom available for study for three reasons: first, during a given period, conditions will only accidentally be favorable for such stratification as will furnish a continuous record of the period; second, after it is completed it will be saved only by accident from destruction by the igneous agencies that have been so active in the region to be described; and lastly, if formed and saved, it may be covered either by later sediments or by volcanic outpourings, and only in places will erosion or other agencies expose the formation for our study. The successful study of any district therefore is based on the patient collection of all possible observations, imperfect as they may be, each represent-

ing a mere glimpse of what has happened. It is from the assembly and correlation of these glimpses, fitted to each other by intelligent conjecture, that we get a composite picture of the geology of the country.

In geologic study, time is measured in much larger units than those employed by the recorder of human affairs. For the natural forces of erosion, wind motion, or evaporation to make even the smallest impression in their allotted work of tearing down and transporting rock-masses, the years must be counted by the thousand. When we speak therefore of recent geologic time we mean two or three hundred thousand years ago. It is in this Recent period that practically all of the visible progress has been made in preparing the globe for human habitation. To us, naturally, that seems the chief end of the whole process of nature.

Our necessarily artificial classification of geologic time into periods has a perfectly sound basis in the alternation of volcanic activity with periods of rest, during which breaking down of the surficial rocks may cause deposition of sediments. Such volcanic action, in the shape of eruptions, of outpourings, or of intrusions of igneous masses into already existing rock structures, has been recurring intermittently from the earliest periods recorded. As soon as the disturbance is over, the agencies of destruction and transportation begin their work of taking material from the existing surface and carrying it to some other point lower down. The period of rest from igneous activity therefore results in the deposition of sediments in the low-lying areas; and as settlement takes place under the sorting action of either water or wind, the sediments assume a definite character of their own, making a record of the period. As soon as volcanic activity recurs, some of these sediments are disturbed, others destroyed, others are covered by ash or lava; and the period is ended, with a new one beginning as soon as the eruptive disturbances are over.

The accepted classifications distinguish between four great time-divisions of geological history: first, the period of Ancient Rocks, the Archeozoic and Proterozoic eras, periods so vast in time, of such intense and prolonged vulcanism, and of so few fossil remains, that our knowledge of them is still largely conjectural. In Mexico these rocks are old granites, gneisses, and schists, inconceivably twisted and altered, like the Archean complex, to which they are generally referred. Between this and the second grand division, that of Old Life (Paleozoic), there is a great gulf fixed. From the earliest stage of Paleozoic time (the Cambrian) to the present day everything is more definite: prior to that period we have the enormous time-spaces, as yet imperfectly

understood; it has thus become convenient to apply the name Pre-Cambrian to rocks believed to belong somewhere in the Ancient series, but whose correct place it is as yet impossible to fix accurately. In the third and fourth grand divisions, the most important by far to Mexico, we include all the periods of Modern Life, the Mesozoic and Cenozoic of the text-books. We shall find that while the older ages are represented here in small areas, the last two periods, those of Modern Life, completely dominate our horizon and make Mexico a new country in the fullest geologic sense.

The Paleozoic is represented by intrusives later than the Cambrian, belonging to a time as yet not fixed precisely. They are chiefly rocks of granitic appearance, and are widely scattered through Pacific Mexico in small masses, except in Lower California, where they cover half the State. Similar intrusives occur in Chihuahua, Sonora, Sinaloa, Durango, Tepic and Jalisco, Guerrero and Michoacan, Oaxaca and Chiapas. There are also small Paleozoic areas (Devonian and Carboniferous) in the Yaqui River valley of Sonora, in northern Lower California, and on the border near Bisbee. Every-



FIG. 1

The Pre-Cambrian period in Mexico is represented by the rocks already mentioned, and by hardened and altered sediments, in small areas scattered along the western axis of the country, from Sonora down through Puebla and Zacatecas, by larger spaces in Michoacan, Guerrero, Durango, and Sinaloa, and by important areas in Oaxaca.¹ Many of them have been described as Archean; some, it is thought, may be Paleozoic or even later. Hence the preferred designation is Pre-Cambrian. There are some gold veins in these formations, but of minor importance. Perhaps the chief feature of interest for us is the fact that the ore-bearing veins, found in overlying later formations, are apt to pinch, impoverish, or disappear on reaching the very old rocks.

¹'Stratigraphy of North America'; Bailey Willis, Prof. Paper No. 71, U. S. G. S., 1912.

thing else in Mexico, and practically everything in the nature of widespread and thick formations, belongs to the later periods, the Mesozoic and the Cenozoic, the periods of Modern Life.

Of the Mesozoic formations, the Triassic and Jurassic are not of great interest to us, although to the student nothing could be more remarkable than the development of the huge reptiles and birds of the period. The second part of the division, the Cretaceous, holds for us first place in economic importance.

There is a small Triassic area at the southern boundary of Coahuila, a narrow strip in Nuevo Leon, and there are insignificant areas in Chiapis and on the Oaxaca-Puebla boundary. Later than these are the small and scattered Jurassic areas, one at the junction of Coahuila with Durango and Zacatecas, two in San

Luis Potosi, one in Puebla, one in Hidalgo, and two in Oaxaca; all small, but sometimes of importance from their association with mines. On top of these rest the great limestone deposits of the Lower and Upper Cretaceous, and on top of these the outpoured volcanic rocks of the Tertiary.

The Cenozoic period, the last grand division, is conveniently, but loosely, divided into Tertiary and Quaternary time, the former being the earlier two-thirds of the era, the period of sustained volcanic action on a scale more enormous than any since the beginnings of the Paleozoic. The later, or Quaternary, is the period of the present day, geologically speaking, covering the advent of Man on the earth, and bringing the succession up to our own time.

The Tertiary period is next in importance to the Cretaceous, in Mexico, and between them they cover the greater part of the country. The Quaternary deposits, covering much of the West Coast and part of the Central Plateau, are also represented on the Gulf Coast, and as regards area, are third in importance.

It will be evident from the foregoing that the older formations were well represented in Mexico prior to the Cretaceous, but that the mantles of limestone rocks deposited on them during that period, followed by great outpourings of volcanic rocks during Tertiary time, covered all the old topography, leaving the then visible Mexico as a new country of limestones and eruptives. Subsequent tearing-down by atmospheric and climatic agencies has uncovered the old formations in the scattered localities listed, and at the same time has caused the deposition of waste material—the modern Quaternary beds. A sufficiently correct grasp of the general geology of the country will be obtained if it be understood that practically all of the eastern half of Mexico is Cretaceous, Lower and Upper; that in the Central region, about half-way to the Pacific Coast and down to Guerrero, stretch the Quaternary sediments, including a strip on the Pacific Coast itself and one on the Gulf Coast; and that the Tertiary lavas cover the whole mountain chain or Cordilleran region, forming the axis of the continent. The Quaternary, therefore, lies between the Cretaceous and Tertiary areas, and is made up in large part of broken-down material from both.

CRETACEOUS. In Mexico this period is represented by the Lower Cretaceous or Comanchean, the Eo- and Meso-Cretaceous of the Mexican Geological Survey. The Upper Cretaceous "while present is less wide-spread and less thick than the preceding system."² The period is as complete in North America as in Europe; "the Arkansas-Texas section shows the presence in America, as well as in Europe, of a most perfect section of Cretaceous deposits—which embraces all Cretaceous time."³

For Mexico, the Lower Cretaceous is a peculiarly interesting period. The North American continent as a whole was mostly above water, the general submergence

being considerably less than during the Upper Cretaceous. In Mexico, however, this relation was reversed; the country was almost entirely submerged, there remaining only the peninsula of Lower California and a narrow barrier of land on the Pacific Coast, which kept out the waters of the western ocean. The slow subsidence of material to the sea-floor, continuing with but slight disturbance for thousands of years, deposited strata of enormous thickness. Estimates range from 10,000 to 20,000 ft. according to locality.⁴ Although this has been exceeded in isolated localities in California, the development of the Lower Cretaceous as a whole was more complete and more remarkable in this country than anywhere else in the world. It will be recognized that whatever the Jurassic topography may have looked like at the beginning of the Comanchean, it must have been completely buried by the limestone deposits, just as snow fills up a hollow. It is for this reason that the areas earlier than the Cretaceous are confined to the small and isolated groups enumerated above. They are all that is visible of the buried masses.

The end of the Comanchean was marked by a strong warping of the continental surface, bringing the western axis high out of water and temporarily elevating most of Mexico, so that erosion and wind action could come into play. This continued for an era sufficiently prolonged to give rise to a characteristic Lower Cretaceous topography.

With the beginning of the Upper Cretaceous, the continent again sank into the sea, this time on a great scale except for Mexico. In this country the eastern half was entirely submerged, the central plateau only partly. As sedimentation went on as before, the new limestones and shales were deposited on the eroded Comanchean topography except in a few instances; and while these strata are not nearly as important as the Comanchean, they covered a great deal of the Gulf Coast and reached as far west as Coahuila, where the coal measures belong to this period. The Upper Cretaceous is the coal period in Mexico.

For us who are interested in the ore deposits of this country, special interest attaches to the latter part of this period; it marks a rapid succession of events in which enormous forces were at work in a dramatic way, with the result of making the mineral regions that we exploit today. The great volcanic eruptions, which we hold were primarily responsible for the beginnings of mineralization, began in the latter part of the Upper Cretaceous, they brought the period to a close, and continued on an enormous scale through the first part of the Tertiary, the Eocene period.

TERTIARY ERUPTIONS. It is now generally held that all ore deposits, except such as are obviously the work of sedimentation in shallow waters, like some iron deposits, have a close connection with igneous action, and that most ore deposits may be traced to the nearest intrusive volcanic rock-mass. It will follow that every geologic period is likely to have originated ore deposits

²Chamberlain and Salisbury, 'Geology', Vol. III, p. 143.

³Hill and Vaughn, 'Lower Cretaceous Gryphea', Bull. No. 151, U. S. G. S., p. 17.

⁴R. T. Hill, 'Growth and Decay of the Mexican Plateau', E. & M. J., Vol. 85; also 21st Ann. Rep. U. S. G. S., Pt. VII.

in connection with its own eruptive phenomena. Owing to the enormously superior importance in Mexico of the ore deposits that began in Cretaceous and Tertiary times, the varied steps, presumably more or less alike in different ages, that have given rise to ore deposits, will be described under the heading of the Tertiary period.

Until the close, then, of Cretaceous time, variously estimated at between 200,000 and 300,000 years ago, Mexico was almost entirely under the waters of the Gulf. The oscillation of level prior to that date sufficed to distinguish between the Lower Cretaceous, or Comanchean, laid down during the first submergence of the greater part of what is now Mexico, and the Upper, or true, Cretaceous laid down during the second or lesser submergence. Near the end of the latter, volcanic action broke out on a scale of such gigantic splendor, with consequences so far-reaching, as the earth had not seen since the Archeozoic era.

All along the Pacific axis, the pressure of huge masses of molten material beneath the existing surface began to push that surface out of shape in an easterly direction, folding and crumpling the sediments. Eastward folds, lying today in the position into which they were squeezed, attest the force of the pressure. At the same time, more or less uniformly over the whole area, but perhaps a little more on the Pacific coast, a gentle and steady uplift began, part of a general elevation of the continent; this continued with few oscillations till the Gulf Coast had been raised some 5000 ft. above sea-level and the Central Plateau region between 5000 and 10,000 ft. For a perspective view of these events, it is only necessary to consider the Santiago River canyon in Jalisco, on the Tepic border, where lies spread out in a vast cut, more than 3000 ft. deep, the topography of Tertiary lavas through which the river cut its way while the whole country was being lifted bodily.

The agencies of land degradation being fully as active then as they are now, erosion and the carving out of topography proceeded rapidly, so that by the beginning of the Eocene, the first part of the Tertiary, the first truly modern period, the topography of this limestone plateau had been dissected deeply. With some changes, the distinction then made between the two coasts has been maintained: the Gulf Coast is sea-bottom that has been raised slowly to nearly its present position, whereas the Pacific Sierra region and the northern part of the Central Plateau are the much cut-down remains of the originally higher ground. In other words, until the beginning of the Tertiary, Mexico was a limestone country, uplifted from the sea-bottom, compressed in places into mountain-folds, carved by erosion into deep valleys and great mountain ranges.

Following these movements there have been renewed subsidences and elevations, which have left their records in the various sediments of the period; but for us, the events of first importance were the great volcanic eruptions, which changed our world in Mexico and were the beginning of the country as we see it today.

The irresistible swell of molten material from the

depths, which had been making itself felt along the Pacific axis in the folding of the strata, could no longer be contained, even by the thousands of feet of overlying sediments; the red-hot material, under enormous pressure, forced its way steadily through the lime, seeking and finding points of weakness scattered along the whole western coast-line. With stupendous force, and pouring forth incalculable masses of melted rock-stuff, the earth opened in thousands of vents. It is hardly possible for us to conceive the appearance of the Mexican plateau at this period. With thousands of volcanic openings in full or partial eruption, sometimes on dry land so that glowing lava-sheets crept over the surface, sometimes during a period of subsidence, so that the hissing ashes fell into the sea, the sight must have been unendurably grand, had there been human eyes to witness it. For a period that was geologically short, but that numbered many thousands of years nevertheless, these tremendous furnaces smoked and flamed, and rock by the thousands of square miles was poured out over the Cretaceous surface. In most places the molten masses filled the valleys that Nature had patiently carved out, and submerged the Cretaceous mountains in the sea of lava. The activity became less intense with distance from the Pacific axis, so that volcanic action was of less importance on the Gulf Coast; but on all the Mexico that was in the zone of eruption, that is, on all of present-day Mexico except small areas in the south, near the Gulf, and in Sonora, the effect was to bury out of sight the Cretaceous topography under thousands of feet of igneous rock, just as during the long Cretaceous sleep the effect had been to bury all the older formations beneath thousands of feet of limestone sediment. "The old order changeth, yielding place to new" was never more strikingly exemplified.

Most of Mexico was thus covered under a smoking mantle of hot mud, ash, and lava; the volcanoes subsided into fitful activity; a new era began in the making of topography. As the ground cooled, the forces that had sculptured hills and valleys and river systems during the Cretaceous now set to work on the igneous mass. This material varied considerably during the different eruptions. The earliest lavas were andesite, a rock of intermediate composition as regards the amount of silica present, that is, the so-called acidity; following these came rocks of more extreme type in both directions: rhyolites in the acidic or more silicious extreme and basalts in the basic or least silicious class. All these rocks are merely different phases of the same original material, and in crystallizing they followed recognized laws. Rocks of all three types were extruded in nearly every period; but in a general way it may be said that the andesites came first, the rhyolites next, and the basalts last. The most important andesitic masses made their appearance during the middle stage of the Tertiary (Miocene), being the green augite-andesite or hypersethene-andesite, which contains so many important ore deposits.

FORMATION OF LODE-CHANNELS. The close of the

period of violent eruption was followed by spasmodic but slowly declining activity, continuing to the present day; the resultant cooling of the great igneous masses gave rise to a series of tension phenomena that were fundamental in originating the orebodies of the country, in that they produced the fractures in which those orebodies have been formed. The vast sheets of lava, some of them thousands of feet thick, began to cool and settle on their beds of limestone or ash; and besides the climatic or atmospheric influences that busied themselves in making the new topography, there began to take effect the forces of tension and compression on these rock-masses on a tremendous scale. As the rock cooled it slowly contracted, forming many intricate systems of fracture. As the fracture-blocks settled, other movements were set up, splitting them further, sometimes cutting across already existing cracks. Meantime, the occasional repetition of eruptive action pushed new masses of rock into the already disturbed ground, causing still further complexity of fracturing. The result of all this was to create throughout the region of vulcanism an infinite number of cracks in the earth's crust, of every conceivable shape, size, and direction. It is with these cracks, or the lines of weakness along the contacts of different kinds of rocks, and with the minerals that have formed in or on them, that we have to deal in studying the origin of ores. For it may be said roughly, but with confidence, that in order to have an ore deposit two things are necessary; first, fractures or other channels in which circulation of metal-bearing solutions can take place; and second, the metal-bearing solutions themselves. Not only were cooling-cracks in the intrusive rocks available as channels, but the sediments thus intruded, violently pushed out of place, were cracked on a great scale, the fractures naturally having direct communication with the eruptive mass; and the contact of the eruptive with the intruded rock, on account of difference in chemical composition, would always remain a line of weakness for ground-waters to follow.

MINERALIZATION. Perhaps the greatest controversies, and certainly the most inconclusive, in the study of ore deposits, have taken place over the manner in which these fractures are supposed to have become mineralized. As the science has progressed there have arisen successive schools of thought that have laid down dogmatically the manner in which ores have come into the veins where we find them, only to have their theories modified or disproved by later investigations. So much progress has been made in this work during the past ten years, principally along chemical lines, that much has been established that was formerly mere conjecture; and while much remains to be done, we are now in a position to outline the phenomena of ore-making with a considerable basis of proof and with little controversy as to fundamental principles.

A great obstacle to the progress of the science was removed when it was recognized that no one suggested agency was in itself sufficient to account for the conditions that we find in mineral veins, but that each of the

different processes put forward had its own particular virtue, which might well have been operative at the same time as any or all of the other agencies. Up to the point of formation of the fractures, the problem is largely mechanical, and there was no irreconcilable difference of opinion. Beyond that point each school claimed that some special process made the vein-filling. The lateral-secretionists insisted that the open fracture was slowly filled by the seepage of material through the walls, which crystallized in the opening, and gradually filled it; the material being derived from the wide circulation of ground-waters and the leaching of metallic salts. This was supplanted by the ascensionists with the theory that the waters came from great depths, where in some way they had access to mineral solutions. Finally, in our own day, investigators like Emmons, Lindgren, and Ransome have established the importance of the working-over of veins by descending metal-bearing solutions, and deposition from them on already existing metaliferous deposits. From this to the conception of ascending or circulating solutions effecting the same operation, of enriching an already existing deposit, was a natural and logical step. Finally, under the leadership of Vogt, Spurr, and Kemp, the importance of segregation from the magma, that is, of direct precipitation into place from the original rock-solution, has been universally recognized, and assigned to an important place among mineral-making agencies.

It will be observed that there is much truth in each of the theories advanced, and our thought today retains the essential kernel of truth in each of them. It was the tendency of early investigators to make a fetish of some one process, perhaps it is the tendency today; but at least we now recognize that all these agencies have their place and their use, and our knowledge is sounder for the admission. We now believe, on the basis of evidence broader and more scientific than what used to be accepted as such, that mineralization began to a certain extent when fracturing began; that every stage of disturbance and re-adjustment has had its accompanying stage of mineralization; and that the process was and is a purely chemical one, involving on the one hand the crystallization of metallic compounds out of watery solutions into a gathering place of some kind, and on the other hand, the dissolution and transportation of these metals from the original deposit to any other place to which the solutions may find their way. The principal point of dispute has remained the origin of the water that forms the solutions and carries the metals.⁵

The ideas of fifteen years ago as to the circulation of meteoric or surface waters to vast depths, with Van Hise as their leading and brilliant exponent, have not been confirmed by later developments in numerous deep mines. The theory, presented in the most convincing way, was that the waters performing the work of ore

⁵Van Hise, 'Some Principles Controlling the Deposition of Ores', *Trans. A. I. M. E.*, XXX, p. 27. Kemp, 'The Role of the Igneous Rocks in the Formation of Veins', *ibid.*, XXXI, p. 175; Spurr, 'Igneous Rocks and Their Segregation', *ibid.*, XXXIII, p. 288.

deposition come principally, if not altogether, from the surface precipitations of rain and snow; and that prolonged circulation to immense depths gives them the characteristics of heat and composition that are necessary for the work. The observations of Kemp, Rickard,* Finch, and others have shown that deep mines are nearly always dry when surface drainage is properly handled. The surficial waters, upon whose deep circulation such a complex theory of solution and re-deposition was built up, do not get down more than a few thousand feet.

Again, our most recent ideas on the origin of ore-

forward two fundamental conceptions as to origin, to which all phenomena may sooner or later be referred: first, as to the primary origin of the minerals found in orebodies; and second, as to the primary origin of the water that effected the work of transportation before deposition commenced and during the process. These concepts are the basis of the magmatic theory of the origin of orebodies, and it is believed that it fills the requirements reasonably. It has become widely accepted, and is the working hypothesis, at least, of many mining geologists.⁶



FIG. 2

bodies involved the conception, in some form, of general dissemination of the metals in minute traces through the earth's rock-masses; the metals being extracted by these deep-sunken waters, and carried into fractures to be deposited elsewhere. These ideas were based on wide experience and observation and were sound insofar as they referred to the shallow depths to which groundwaters circulate. The theory has been transferred bodily to the phenomena of secondary enrichment, in which it finds wide and important application. But the origin of the metallic masses which are attacked and dissolved by the circulating waters must be explained in a different way.

It seems to me that the work which has been done in economic geology during the past ten years has brought

THE MAGMATIC THEORY. For the purposes of this paper, the theory may be generalized as follows: the fused mass of rock-material in the depths of the globe, from the reservoirs of which all volcanic outpourings draw their lavas, is the magma, that is, the original rock-stuff from which all minerals are differentiated by more or less complex processes. This magma contains not only the minerals, as yet uncrystallized, which make up all classes of igneous rocks and all varieties of metallic minerals, but more important still, it carries abundant water and gas, in chemical combination with the other elements.

If we regard this magma as a solution, under pressure and high temperature, it is evident that any change of condition will cause immediate crystallization of some, at least, of the dissolved ingredients; and that the re-

*'Water in Veins—a Theory', E. & M. J., March 14, 1903, and 'Waters Meteoric and Magmatic', M. & S. P., June 27, 1908.

⁶Kemp, 'Theories of Ore Deposition', A. S. M. M., quoted in Mex. Min. Journal, Sept. 1915.

sult of such a crystallization will be not only the solid masses of rock or mineral that have been precipitated, but also the thin and watery solution remaining. In this solution, such ingredients as the rarer metals, that is, all metals except the iron-chromium group, will still be carried until favorable conditions induce precipitation. Any intrusion or outpouring of igneous rock, therefore, represents such a separation of the rock-making minerals out of an original solution, in which metallic and other minerals remain. In exactly the same way, possibly at the same time, the greater part of the iron or chromium minerals may separate out, gathering in a suitable place, and forming a magmatic segregation of these metals.

The magma, itself of intermediate composition, has a tendency to form the two extremes of acid and basic rocks, or, more accurately, the most silicious and least silicious rocks; the basic ones first, the acid ones last. Pure silica is the last substance to crystallize out; that is, a preferential separation of certain elements results as soon as crystallization begins at all. Now, it is an undisputed fact that the igneous rocks crystallize out from the magma; and there is general agreement that certain deposits of iron, chromium, and nickel are also crystallized directly from the magmatic solutions; and certain quartz-dikes carrying gold, as well as some platinum deposits, are believed to have originated in a similar way. General acceptance of the magmatic origin of the iron deposits came first after hard fighting; it has been followed by agreement as to many other deposits, as proof accumulated.

The next question is, what was the origin of the great bulk of deposits that have made profitable orebodies? The answer is difficult because of that word "profitable." If a deposit is not profitable it soon ceases to be exploited, and consequently our knowledge of it remains limited. On the other hand, we know that nearly every deposit that can be profitably worked, and many that cannot, have been gone over with minuteness inconceivable by later enriching, or leaching, solutions; that is, the original structures have been so altered and masked by later action that it is sometimes very difficult to find out what elements were first deposited, and what came later.

There are certain precious-metal deposits, like the Campo Morado lead-silver-gold mine in Guerrero,⁷ that we agree in imputing to primary deposition from metal-bearing solutions. Do such solutions owe their water to meteoric sources and their mineral to leachings from buried masses? Or are they in any way to be compared with the magmatic solutions from which the admitted nickel and iron solutions were thrown down?

Any mineral crystallization, in place as an ore deposit, may be regarded as a stage in a series of successive precipitations. The variety of minerals to be found there may be viewed as successive steps in the fractional precipitation of the various minerals from the mother-liquor. Each one of the minerals has its own

degree of solubility, and so has each gangue-mineral. If in a solution resulting from the formation of igneous rocks there remain present silver, copper, iron, and other metals with silica and lime, then under certain conditions the silver might be thrown down first, followed by the copper, with the silica (as quartz) remaining to the last. Especially will precipitation occur in the presence of metals already deposited. A great deal has been done on this subject, in the laboratory, and much remains to be done; it is clear, however, that the question of precipitation must be mainly a matter of solubilities and chemical equilibrium.

The fact that gold is almost invariably associated with silica has been worked out in detail, and certain gold-quartz dikes have been shown to be magmatic segregations.⁸ If we extend the conception of the association of silica with gold, to include the other metals, excepting the iron-chromium group, then we have the type process as follows: the silicious metal-bearing solutions, remaining after the rock-minerals crystallize out of a magma, may find their way into a fracture or channel, under favorable conditions of heat and pressure, and encounter a precipitant. The various minerals present will come down in the order of their solubilities, generally speaking. The lead, let us say, will come down in crystals of galena, on the walls of the channel. Soon after, the silver will be precipitated, perhaps in combination with antimony or arsenic, the crystals resting on the earlier ones and building out toward the centre. Then, perhaps, the silica will increase sufficiently in strength to precipitate also, either in shapeless masses or as beautiful crystals resting on the others and nearly or quite filling the cavity. The process may be repeated several times if the channel is wide enough and the solutions repeat their entrance. The point to be emphasized is that the process is as purely a chemical one as the making of rock-candy from a sugar solution. The difference is that we make the sugar solution ourselves and then set all the conditions of temperature for precipitation; whereas we do not make the rock solutions and have no control over the conditions under which they work.

Such a condition of metal-carrying and of precipitation through differing solubilities exists whether the water that serves as a vehicle comes from the surface or from some other source; but it is obvious that if the rock-making minerals suddenly or slowly solidify out of a magmatic solution, we do not have to look for sources of water to effect all the operations discussed: the water is automatically there in quantity and with the metals already in solution.

We now see whence has arisen such a wide divergence of view between the opinions held by the school of Van Hise and those brought forward by Spurr and Kemp. The former conceive all ore deposits, exclusive of the admitted magmatic segregations first mentioned, to be due to deep circulation of meteoric waters, with mingling

⁸Spurr, 'Yukon Gold District', 18th Ann. Rept. U. S. G. S., Pt. III. Also Trans. A. I. M. E., XXXIII, p. 228.

of solutions of varying composition and resulting precipitation of minerals. The theory is sound as applied to shallow waters, but can only hold for the origin of most vein and contact deposits if it can be shown that meteoric waters can get down deep enough; or, if that cannot be shown, if it can be suggested that in some manner the mineral can be brought within the reach of these meteoric waters. The later investigators, by showing that the circulation of ground-waters of meteoric origin is restricted to a comparatively shallow zone, brought forward the present-day thought that the amount of water contained in igneous rocks when they are still molten is sufficient to serve as a vehicle for all the dissolved mineral matter that they bring up. This dissolved mineral matter must be precipitated somewhere, given favorable conditions: it is conceivable, and seems probable, that in some cases at least, precipitation of silver or lead minerals, for example, may have occurred out of such a solution due to lowering of temperature or pressure or both, such as might occur in the interior of a slowly cooling igneous mass. This would be a true magmatic segregation of the minerals mentioned; it would remain unchanged till later movements and the breaking-down of overlying rocks could bring the deposit within the reach of enriching solutions. But the limiting condition of such deposition, that it must take place within the interior of a great mass, uncontaminated by outside influences, makes it clear that such deposits can neither be numerous nor can they be easily brought within the reach of mining. Many igneous structures are lava-flows on an existing surface, hence immediately subject to cooling, to the formation of fractures, to deposition in these fractures from the solutions that have been described, and to immediate influence from oxidizing and meteoric agencies. By far the greater number of igneous structures that are not such flows are associated as intrusive masses with older rocks: and in these associations the contacts and the fracture in the intruded rock play the chief part in receiving mineralization. If a true magmatic silver deposit should be formed in the interior of the intrusive rock, with no communication with the outside, such a deposit will only be uncovered and come to our knowledge by an extraordinary combination of accidents. Before it is uncovered, later movements of the ground may allow circulating waters of meteoric origin to get in, to leach the deposit of some of its metals and carry them to some other point, or at once to enrich the magmatic deposit. Such may be the source of the metals in some ore deposits. In considering this, however, it would seem probable that the greater part of the thinner magmatic solution left after the rock-minerals form must find its way in great quantity and at once to the outside of the intrusive mass, there inevitably to be influenced by the physical conditions of the contact.

It seems logical to suppose, then, that true magmatic segregation of such metals as silver and copper may have taken place more or less as has been outlined; and that circulating waters of surface origin in the course of time reach some of these deposits, to leach and carry

away their metallic content. It is believed that, as research progresses, this will prove to be the case in an increasing number of instances. At the same time, it seems probable that the greater number of valuable ore deposits must have resulted either from the enrichment of such primary bodies by later mineral-bearing surface waters, or from the reaction of the magmatic solution proper with circulating meteoric waters or with other oxidizing conditions.

ENRICHMENT BY CIRCULATION. Primary ore deposits are merely a first concentration from an exceedingly dilute solution, speaking with reference to any particular metal. It is evident, therefore, that they will almost necessarily be very poor, economically speaking, and the instances are rare where such a first deposition of other than iron minerals has made a valuable ore deposit. The Campo Morado mine is the best example in Mexico, and it is a remarkable exception. The first deposition, as a rule, is simply a geological concentration of the metals, lacking a great deal of further concentration to give it economic value. We know little about such primary deposits, because the majority, not repaying exploration, are soon abandoned or are never worked at all. It takes the circulation of later waters, working for long periods of time, to effect this subsequent re-concentration. Such a later circulation can only take place when erosion or upward movement, long after, exposes the primary deposit to the influence of surface waters or to the atmosphere, when a new chapter is begun in the life-history of the deposit.

This phase of the subject, the gradual alteration of primary mineral into ore, or rock that it will pay to mine, has in the past decade been studied with great enthusiasm and success,⁹ especially by American geologists. With the appearance of Posepny's paper and the ensuing discussion came a period of vigorous constructive thought on the subject, which had as its most important result the crystallization of the idea that it was not alone by ascending waters, nor by descending waters, nor by lateral secretion, that deposits of mineral are formed or modified, but by a combination of all of them, that is, by circulation of the ground-water. Waters, coming from intrusive masses and finding their way into channels in the rocks continue to move if they can. Such recently-formed (juvenile) waters are generally alkaline in reaction. Waters from the surface (meteoric), coming from rain or snow, soon become acid on sinking into the ground, due to picking up carbonic acid or traces of salts. We find that such acid waters, descending in veins, soon lose their acidity by contact with alkalis, either in the rocks or in the other solutions. The meeting and mingling of such acid and alkaline waters in the channels causes an interchange of burdens; the acid radicals react readily with the metals, the alkaline bases with the earths; the result is precipitation. Given a primary deposit containing

⁹'Enrichment of Sulphide Ores', W. F. Emmons, Bull. No. 529, U. S. G. S.

¹⁰T. A. Rickard, 'The Genesis of Ore Deposits', A. I. M. E., p. 219.

metals combined with sulphur in some form, which seems to be the usual form of primary deposition—there will occur precipitation on these sulphides if later solutions carrying the same or similar minerals come in contact with them under favorable conditions. If this is kept up for sufficient time, there is enrichment of the deposit. The process is unending. It began when Mexico was still a fiery furnace, early in the Tertiary, and it is going on today. The waters, both from magmatic sources and from the surface, take up their burden of dissolved material, and with all the infinite variety of combinations that result from varying pressure, temperature, class of wall-rock, openness of channel, and chemical composition, they go about their work of changing the nature of what they find. They dissolve valueless material from some deposits, leaving an oxidized mass, or 'gossan,' that perhaps is profitable: or they dissolve out valuable material, carry it to another place, and if they encounter right conditions they drop their burdens, enriching what already existed. This process, in its varying activities, as downward secondary enrichment, as upward secondary enrichment, or as enrichment by the circulation of metal-bearing surface-waters, has been shown to be the most important known agency in the working over of originally lean primary bodies till they are fit for exploitation. We learn from its study that today, when we find profitable ore, we find material which as a rule has not been deposited just as it is, but which is the result of complicated and long-drawn out re-concentration of originally poorer material.

To summarize: the primary deposit is a matter of great depth and of water derived from the great igneous masses, whereas the enrichment of such a primary deposit or its leaching for transportation to other places, is a matter of circulation in shallow depths of any waters that can reach it. To get this circulation, the primary deposit must be lifted to the surface face, or the surface must be cut down to it; if, through being covered by cap-rock or for some other reason, surficial agencies cannot affect it, enrichment, generally speaking, cannot occur.

Such in a general way has been the nature of the agencies that have formed orebodies. As soon as we begin detailed study, we find an infinite variety of special conditions, which have influenced deposition so that no two deposits are exactly alike in any respect, and nearly every one presents some feature peculiar to itself alone.

(To be continued)

IN 1918, 15,445 tons of lead, valued at 13,193,100 francs, was exported from Tunis, almost exclusively to France; in 1917, foreign shipments of lead amounted to 18,713 tons, 15,794,785 francs in value, following the highest smelter production ever attained there. The average annual value for the period 1908-1917 of exports of lead was 3,638,000 francs, and the quantity, 4851 tons. A comparison of the 1917 and 1918 figures with these averages indicates the impetus of war conditions.

Mogollon District in New Mexico

*The Mogollon mining district has received little public attention, although for 15 years it has been the leading silver producer of New Mexico; it is situated in a region remote from the principal lines of travel, and its activities have usually been limited to the operations of two or three companies. The value of the total production of the district in the 44 years of its history has been estimated at \$15,000,000. For the years 1904 to 1917, inclusive, the output was: gold, \$4,370,000; silver, 10,042,000 oz.; copper, 874,862 lb.; total value, approximately \$10,500,000. In 1913 the district contributed 80% of the total silver production of New Mexico, but in 1917 only 41%, due to serious interruption in the operations of the leading producer. Since 1914 the silver output has diminished one-half, and the present high value of silver is nearly offset by the increase in cost of production. The output of gold has rarely exceeded 35% of the total for New Mexico. The ratio of silver to gold, by weight, has averaged 46:1 based on the whole output of the district. The town of Mogollon is 75 miles by a poorly located highway from the nearest railroad terminals, at Silver City and Tyrone. All supplies are transported by motor trucks and teams.

The area, sometimes called the Cooney mining district, lies on the western flank of the Mogollon mountains. The topography is rugged, the whole area being sharply dissected; deep canyons with steep gradients and rugged walls are characteristic of the whole western slope of the Mogollon range. The water resources in the neighborhood of the mineral area have been developed in a sporadic way; Mineral and Whitewater creeks have both furnished water-power at various times, but the extreme annual variation and the relatively small volume of the streams both necessitate large capital outlays for power development.

In 1875, J. Cooney noted the presence of copper-silver ore in the Mogollon mountains, and in the following year he and six others located and operated claims on Mineral creek. In April 1880, Victorio's band of Apaches raided the settlement and Cooney was killed. The village of Claremont was established on Cooper creek soon after Cooney's discovery, and the town of Cooney on Mineral creek soon became the centre of mining activity. The early production was confined to the shipment of rich copper ore which was found near the surface on Mineral creek. Prospecting resulted in the discovery of the silver veins to the south, and in the establishment of the town of Mogollon on Silver creek. These later discoveries led to the development of the most productive area of the district, and practically no attention has been paid to the older sections for 10 years. Improvements of metallurgical processes stimulated the development of the district, and after the introduction of the cyanide process at the Silver Creek mills, mining activity was at its height from 1905 to 1912.

*Abstract from a paper by D. B. Scott, New York meeting of the A. I. M. E.

Physical Examination of Hoisting Engineers in Utah

By C. A. ALLEN and DR. A. L. MURRAY

*In the spring of 1919, the Industrial Commission of Utah undertook the assembling of safety orders covering metal-mining operations. Just at that time there appeared several articles in the mining papers advocating the licensing of hoisting engineers, so this subject was given careful consideration.

The licensing of hoisting engineers means that they must pass an examination covering the mechanical features of hoists and boilers, and must have a certain amount of experience. This undoubtedly serves to get a class of men that are better informed about the mechanical operation and theoretical considerations in hoisting, and the only argument against it is that it is difficult to give an examination that will determine whether or not a man is competent to operate a hoist. A man might pass an excellent examination yet be absolutely unqualified for the actual work, and the judgment of the mine superintendent would have to be depended upon to choose the right man from among those who were licensed. This difficulty of properly determining, by ordinary examination, a man's qualifications to run a hoist caused the idea of licensing in the ordinary sense of the word to be abandoned; but, as there was no question that a hoisting engineer should be physically fit, it was decided to require a medical examination, and at the same time to require the hoisting engineer to state his experience, so that the State would have a better knowledge of his general qualifications.

The orders covering the question were therefore issued as follows:

Section 23. (a) Hoisting engineers shall be appointed by the superintendent, or by the master mechanic with his approval. They shall be men familiar with the details and working of hoisting-engines, shall be able to read and write English, and shall be not less than 18 years of age.

(b) Hoisting engineers, who hoist men, shall be not less than 21 years of age, and, before being allowed to operate a hoist on which 10 or more men are handled daily, the hoist-engineer must be examined by, and present a certificate of health from, a reputable doctor known to be such by the superintendent. This certificate of health must be on a form prescribed by the commission and must show the health of said hoisting engineer to be such that there is no danger of his becoming physically or mentally incapacitated while performing his duties or under the stress of excitement.

(c) All engineers now operating hoists, that handle 10 men or more daily, shall at once be examined and obtain such certificate in like manner, and all hoisting

engineers shall hereafter be examined in like manner at least once every year.

(d) It shall be the duty of the superintendent to permit no other than such duly appointed hoisting engineers to run such engine or hoisting machinery; except that, by and with the consent of the superintendent, specified apprentices may be taught the operation of the hoisting engine at such times and under such restrictions as the superintendent may determine to be free of risk to life and limb. Any superintendent failing to make such appointment of hoisting engineer, or knowingly appointing any hoisting engineer not qualified as above, shall be guilty of a violation of these orders.

(e) At every shaft in which 50 or more men are hoisted or lowered on any shift the commission may require that there be with the hoisting engineer, when the shift is being hoisted or lowered, an extra man sufficiently competent to operate the engine in case of an emergency.

It should be stated that previous to issuance, these orders were submitted to a committee of representative mine-operators and mine-employees and there were no objections raised except to the last paragraph. This paragraph originally made it compulsory to have another man beside the hoisting engineer, when the shift was being handled at the larger mines. The operators felt that this would not be necessary in all cases, so it was changed to be optional with the Industrial Commission as to whether it shall be required or not. The reason for exempting men handling less than ten men was largely one of expediency, but it was also felt that at small properties where few men are working the hoist is usually of slow speed and the engineer is under no particular strain.

After the orders were made effective by the Industrial Commission a form for examination was issued which is too detailed to reproduce here. In drafting this certificate two objects were considered: first, whether the applicant is mentally qualified, and, secondly, whether the physical condition of the applicant is such as to demonstrate his fitness for the work required of him.

The ability of a hoisting engineer to read and write English is practically the only requirement in the way of mental qualifications. He must be familiar with the safety orders of the Commission and of course must be able to interpret properly signals and rules which demand knowledge of English. His other mental qualifications are vitally important, but they can best be judged by the mine superintendent or master mechanic who is acquainted with him. The consideration of the applicant's experience is left also to the mine superintendent, although any man who had not had a reasonable amount of experience, depending upon the size of hoist he is to

*U. S. Bureau of Mines. Reports of Investigations.

operate, would be investigated by the Industrial Commission.

As to physical fitness, the requirements are that a hoisting engineer should be of general good health, alert, and possessed of his faculties of special sense, particularly good eyesight and good hearing. Although the position does not involve severe physical strain, yet a man laboring under certain physical defects may, at a critical time, be so handicapped by such defects that he cannot measure up to the strain placed upon him. Likewise a man who is suffering from some passive ailment such as a disease of the heart, lungs, kidneys, or nervous system would be liable during a period of unusual strain, as in time of a disaster, to suffer an acute attack and become a menace rather than an aid to rescue work. A man subject to fits, vertigo, fainting spells, or epilepsy should never be employed as a hoisting engineer. These conditions frequently result in sudden attacks, and if one occurred while the hoist was in motion the resultant danger to any men who might be on the cage at the time, is apparent.

Eighty-one applicants have filed reports of their physical examination. An analysis of the findings in these reports is given below.

Nationality

U. S. A.	53	Canada	1
England	12	Hawaii	1
Finland	5	Austria	1
Sweden	4	Italy	1
Norway	2	Servia	1

The above table shows that of the eighty-one applicants more than 65% were American born.

Ages

Under 25 years.....	4	45 to 55 years.....	20
25 to 35 years.....	27	Over 55 years.....	10
35 to 45 years.....	20		

Of those applying for positions as hoisting engineers 82% were between the ages of twenty-five and fifty-five years. The youngest applicant was twenty-two, and the eldest was sixty-six years of age.

Length of Experience

Less than 6 months.....	5	2 to 5 years.....	12
6 months to 1 year.....	8	5 to 10 years.....	17
1 to 2 years.....	9	More than 10 years.....	28

Two applicants failed to state definitely the length of time they had been engaged in hoisting-work. It will be noted that in all but thirteen instances the returns show that the applicants had experience covering more than one year.

The physical examinations show in most cases that the applicants were in good general physical condition. In two cases summary refusal of certificates was recommended. *Case I.* A man 61 years old, both eyes 20/50, right ear 50% normal, left ear 25% normal and exaggerated reflexes. *Case II.* A man 40 years of age, lost reflexes, suffering from occasional vertigo and presenting a history of syphilis.

In several cases where the eyesight of the applicant was defective but capable of correction by properly fitted

glasses, and in a case of hernia where no statement was made as to the wearing a truss, action was held in abeyance until a report showing that these defects had been corrected.

Twenty cases of defective vision ranging from 20/30 to 20/100 without glasses were shown. Most of these cases were very slight and all were corrected by glasses except three. *Case I.* Right eye 20/20, left 20/100. A letter was written to the applicant suggesting the advisability of having his eyes examined and glasses fitted, and requesting a report of the optometrist as to the results obtained. The report of the optometrist showed a correction in the case of the left eye to 20/50. *Case II.* Both eyes 20/60. A letter was written as above. The report of the optometrist showed a correction to 20/30 with the possibility of return to normal after wearing glasses. *Case III.* Both eyes 20/70. A letter was written as above, but as yet no reply has been received.

Four cases of minor defects of limbs resulting from old fractures were reported, but in no instance was the deformity of sufficient consequence to debar the applicant from the position he sought.

Three cases of hernia were reported, in two of which the applicants were fitted with trusses. The other failed to state if a truss was worn and a letter was forwarded seeking this information. As yet no reply to this letter has been received.

On qualifying for the physical examination, hoisting engineers are provided with a card-certificate entitling them to practice their trade.

As far as has been determined there has been no objection raised to the examination by the men themselves. Those who have expressed themselves to the inspectors of the commission have been favorable toward it. It is well recognized in the mining industry that hoisting engineers, as a class, are men of good judgment, are fair-minded and dependable, and it seems that the engineers of Utah have taken the attitude that could be expected of reasonable men.

In reference to the re-examination of the men yearly, the analysis of the results of the first examination shows that many of the men will be physically fit for a good many years, while others, who have a tendency toward some weakness, should be examined yearly. It may be found advisable to allow the examining physician to exercise some discretion as to the completeness of the re-examination, having before him the results of the examination of the previous year.

ACCORDING to G. L. Logan, Consul at Penang, Straits Settlements, the success of the American dredges now operating in the tin fields of the Malay Peninsula has given marked impetus to the use of such machinery, which is further assisted by the scarcity and increased wages of the Chinese coolies by whose hand-labor tin recovery has been accomplished heretofore. Dredges not only work the virgin fields cheaper but even have been found to work profitably in ground already worked over by primitive methods.

Two Famous Letters From Mr. Hoover

The first is the letter written to Mr. Coudert on the occasion of President Wilson's partisan appeal on the eve of the Congressional elections in 1918. The second is his letter to Mr. Arnold, the chairman of a committee at Los Angeles that wanted to work in behalf of his nomination to the Presidency. Our readers will be glad to have the full text of these important statements.

November 2, 1918.

Frederick R. Coudert, Esq.,
134 East 56th Street, New York City.

My dear Friend:

I have yours of November 2nd in front of me.

My own views are summarized in a word: that we must have united support to the President. In the issues before us there can be no party policies. It is vital that we have a solid front and a sustained leadership.

I am for President Wilson's leadership not only in the conduct of the War but also in the negotiation of peace, and afterwards in the direction of America's burden in the rehabilitation of the world. Our object in this war is to see the establishment of governments in the Central Empires that are responsible to their people. This is the vital safeguard to permanent peace. The passing of their militaristic autocracies must be and is rapidly being marked by such treatment as to put that system out of action forever.

There is no greater monument to any man's genius than the conduct of negotiations with the enemy by the President. There has been a steady growth of realization by the German people and her deluded Allies of the debauchery into which they and the world have been plunged by militarism. The President has by his conduct and word stimulated this realization. He has assured them justice if they themselves will throw off their yoke and he has not hesitated in application of our every resource in force against their military dictators.

If the final overthrow and surrender of autocracy can be accomplished through the German and their allied peoples themselves, the President will not only save the lives of a million American boys and countless innocent women and children, but will have attained more complete victory and a more permanent guarantee of peace than any other means. The President's leadership has gained gigantic strides in this course. The terms of surrender are being made by Marshal Foch and our military leaders. The action of the Bulgarian, Turkish, and Austrian people has or is forcing the acceptance of these terms. The German people will sooner or later do so.

Our objects in the overthrow of all autocracies in Europe and the establishment of government by the people is but part of our great burden for beyond this, when these immediate objects are attained, we still have before us the greatest problem that our government has ever faced if we are to prevent Europe's immolation in a conflagration of anarchy such as Russia is plunged in today.

We must nurse Europe back to industry and self-support and we must ourselves avoid entanglement in the process. This can be accomplished only by this same leadership which has the confidence of the great mass of people in Europe. The President has spoken throughout this war the aspirations of the vast majority of the American people. There is no other leadership possible now if we are to succeed in these great issues.

Yours faithfully

HERBERT HOOVER.

March 8, 1920.

Mr. Ralph Arnold,
Engineers Club, New York City.

My dear Arnold:

I have given deep consideration to the urgent recommendations of the Committee of which you are chairman. Such proposals are indeed a great honor, but I feel that I cannot alter the attitude that I have consistently preserved in these matters. It is, however, due to old friends that I should make this position perfectly clear to you and your colleagues.

First, I am an independent progressive in the issues before us today. I think that at this time the issues before the country transcend partisanship. It is well known that I was a Progressive Republican before the war and, I think rightly, a non-partisan during my war service. The issues confronting us are new and the alignment upon them has not yet been made by the great parties. I still object as much to the reactionary group in the Republican party as I do to the radical group in the Democratic party.

Second, I am not seeking public office and consulting my own personal inclination I do not want public office. I cannot prevent any citizen or group of citizens from agitating that I should take public office, but I cannot conscientiously participate in any organization to that end. I belong to a group which thinks that the American people should select their own officials at their own initiative and volition, and that resent the manufacture of officials by machine methods. I feel sure that if I entered the race for nomination to the Presidency, and undertook to solicit and spend the cost of propaganda and organization, this would be in itself a negation of the right American instinct, because of the obligations that it all implies. I thoroughly believe that I, like any other citizen, should always be ready for service when really called upon, but to go out and try to persuade the public to call me is opposed to my every instinct.

Third, I hope to have the affection of my countrymen, but my ambition is to remain a common citizen, ready to engage in team play with any organization and leadership that has for its objective the consummation and maintenance of great issues in the forms that I believe are to the public interest and benefit. I of course believe in party organization but it must be for the promotion of issues, not of men. I am not a straddler on any issue, I spend most of my time agitating for issues that I believe in. It is the privilege of all of us to hold our own views and it is our duty to express them when called upon to do

so. But no man can be so arrogant as to assume that he can dictate the issues to the American people or to the great parties they support.

Fourth, you and your friends have urged that I should undertake to organize propaganda for myself, as representing issues, by entering into competition for nomination by a great party. Aside from the reasons mentioned above, this implies entry upon a road of self-seeking, whereas my view is that I should agitate for the issues, not for myself. You rightly say that joining sheer organization without issues is simply office hunting without regard to public service.

Finally, I am not so ignorant as not to realize perfectly well that such a course does not lead to nomination to the Presidency, but I would not be myself if I started out on a path of self-seeking to obtain any office.

Yours faithfully

HERBERT HOOVER.

Italian Quicksilver Industry

Monte Amiata, situated in the Grosseto-Siena region, is the centre of the Italian quicksilver industry, and the output from this region represents approximately the entire national production. The ore-producing zone stretches for 40 kilometres (1 kilometre = 0.62 mile) in a direction parallel to the Apennines, and covers an area of 400 square kilometres. The entire region is mineralized, but only special pockets are sufficiently rich to repay the cost of working. There are at present eight active mines. Three mines have lately been worked out and abandoned, but have been replaced by bringing in two new ones.

The most important of the mineral deposits about the Monte Amiata region is red sulphide or cinnabar. Sometimes, but very rarely, the liquid metal is found in the form of minute drops. The wealth of the deposits does not increase with the depth of the mine, but exhausts itself at about 600 ft. The relative superficiality of cinnabar deposits is characteristic of mercury mining the world over. It is an advantage so far as prospecting and operation are concerned, but a drawback in that it shortens the life of the mines, which are exhausted as soon as the bed has been completely mined.

The future of the Monte Amiata region lies in the extension, rather than in the increased depth, of the producing zone. Experts estimate that the region will continue to supply ore in undiminished quantity for several centuries to come. This, however, is dependent upon the discovery and exploitation of new beds. Under present conditions of abnormally high fuel and labor costs, only the richest deposits are being worked at a profit. Cheaper processes of production may be devised that will render available vast deposits of low-grade ore that are not workable at present.

The high cost of fuel is the heaviest item of expense in ore reduction. The ore is always treated on the spot, being first dried in the sun on platforms or in artificial desiccators. The old type of distilling retort ovens have

been given up; they were dangerous because of their mercurial fumes, and uneconomical because of waste. Two types of ovens are now in use—one for the treatment of large fragments of ore, which are mixed with charcoal in simple tank ovens, and special drop or rotating ovens for treating the smaller fragments of ore. Both these types minimize dispersion, but require great quantities of fuel. In addition, enormous quantities of timber are used as mine props for sustaining the 'galleries'. The double call on timber for charcoal and mine props has made a devastating inroad on the scanty forest resources of the surrounding country. It is now proposed to avoid this excessive use of wood by the installation of electric ovens for ore reduction. Water power from the Apennines is available for hydro-electric energy, but electric smelting has not come up to the high expectations of its proponents.

In the course of investigations recently made of the new electric-smelting operations of the Ansaldo company at Cogne, in the north-western corner of Italy, it was found that the estimated cost of hydro-electric energy in the form of continuous current working 24 hours per day and 365 days in the year, must be held down to \$9 per horse-power year to assure commercial success to electric smelting. Before the War the cheapest hydro-electric plant in the world was at Trondhjem, Norway, with an annual horse-power cost of \$6. In Italy, hydro-electric undertakings rarely run under \$100 per horse-power for installation, which gives an interest charge of \$6 to start with; adding to this \$2 for amortization and \$3 for overhead, we get \$11 as the cost per horse-power year. Two minor difficulties add materially to production costs in the Monte Amiata region: (1) The emanations of sulphureted hydrogen, necessitating the extensive use of electric ventilators; (2) the character of the soil—occasional strata of loose soil are encountered, which become saturated with water and cause the galleries to cave in.

As to fuel, native wood and wood charcoal are used, imported coal not being obtainable. The furnaces treat from 14 to 15 tons of ore per day, at a consumption of one quintal (220 lb.) of wood per ton of mineral treated. The above consumption estimate does not include the fuel used for drying the ore, which varies according to the dampness of the latter.

The production of mercury (in tons) in the Monte Amiata (Grosseto-Siena) districts, was as follows in the years 1915-1918: Ore—1915, 110,612; 1916, 132,524; 1917, 113,782; metal—1915, 985; 1916, 1093; 1917, 1071; 1918, 1038. Total production of Tuscan and Idrian mercury in 1918, was: Monte Amiata (Grosseto-Siena) districts, 1038 tons; Idria (estimate of the Italian Bureau of Mines), 600 tons; total, 1638 tons.—U. S. Commerce Reports.

For the advancement of engineering knowledge and practice, the maintenance of high professional standards, and the fostering of a spirit of co-operation a new society, called the Association of Chinese and American Engineers, has been formed in Peking. The provisional constitution was signed by 39 engineers.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

FEBRUARY OUTPUT FROM CRIPPLE CREEK.

CRIPPLE CREEK.—The gold mines of the Cripple Creek district during February, as shown by the reports of the treatment plants, produced 40,541 tons of ore with an average value of \$12.61 per ton, and gross bullion value of \$511,501. The mills handled all but 700 tons of high-grade ore that was shipped direct to the Pueblo smelter of the American Smelting & Refining Co., with an average value of \$75 per ton and bullion value of \$52,500.

The Golden Cycle mill at Colorado Springs reported treatment of 21,000 tons of \$20 ore, with a value of \$420,000 and the Portland Gold Mining Co.'s Independence mill, near Victor, treated 18,841 tons of ore with gold value of \$2.07 per ton. The Golden Cycle M. & R. Co. paid its regular monthly dividend of three cents per share amounting to \$45,000. Miners in the district are now working under either a contract or bonus system and are making high wages, but a shortage still exists of competent miners. So acute is the shortage that in the City of Victor mail carrier service has been discontinued, because of the departure of many miners and their families from the district.

The Portland company reports in sight at the 23rd level of the No. 2 shaft, on Battle mountain, sufficient ore to keep the present force engaged for the next two years. The drift has been extended 500 ft. on the 23rd level, 180 ft. below the Roosevelt tunnel level at 2131 ft., 400 ft. of the drift has been in high-grade ore and the breast is still in the ore-shoot. Pumps easily are handling the flow of some 300 gallons per minute. Sinking will soon be resumed and a 200-ft. lift of the 500 ft. proposed will be undertaken when the work starts.

LEADVILLE.—The Leadville District mill, one of the oldest in Lake county, operated last year by the Colorado Concentrating Co., has been taken over for a long lease by the American Smelting & Refining Co. The plant will be remodeled and re-equipped for experimental tests on Lake County low-grade complex ores, to determine the best adapted process. A large tonnage of low-grade ore can be furnished from the Yak tunnel and other properties in the district. The mill was erected in the early 'eighties to treat iron-pyrite containing lead-silver minerals. It was later remodeled for treatment of mixed lead-zinc-iron ores and has been under many managements in the past thirty years. Recently the plant was re-designed by the Colorado Concentrating Co. Success of the experimental plant will mean much to the district.

After the determination of the process to be used, a plant of large capacity will be constructed by the A. S. & R. Company.

MICHIGAN

QUINCY.—COPPER RANGE.—VICTORIA.

HOUGHTON.—Few companies are doing more for their men, in the way of welfare work, than is the Quincy. Various Christmas celebrations were arranged for the families; the club-house is patronized by the men in large numbers; the library has developed during the year and is used by the men and their families. In accord with the general plan for improving the living conditions, extensions of the sewer system to the homes of employees have been completed. Last year 1000 ft. of main sewers was laid completing a plan of 5700 ft., with 3000 ft. of connections to individual residences. The homes are commodious. The garden space with each home is large and the men are encouraged to plant gardens. The last lot of 50 houses built by the Quincy company was quickly occupied by the men. An improved water supply for the homes was secured by means of drills in the upper levels of No. 9 shaft.

Production of silver from the Quincy continues to be an important item and it is given more attention because of the present high price received. The Quincy at this time is averaging better than 1500 oz. of silver per month. The record for 1919 will be better than 15,000 oz., according to reliable estimates, while the output in 1920 will run close to 20,000 ounces.

Production of copper from the three mines of the Copper Range company, Champion, Baltic, and Trimountain, shows a material falling off in February as compared with January. This is due to two important factors: illness among the underground employees, and the shorter month. On the other hand, in each case there is a slight betterment in the grade of ore secured so that the refined output will not be so much lower. The production in 'rock', compared with the production in January, follows:

	February, tons	January, tons
Champion	38,000	49,000
Baltic	14,000	15,000
Trimountain	12,000	14,500

Like all the other companies of the district the Mohawk output for February will show a falling off when the final figures are in. The tonnage of 'rock' was 39,879 compared with 46,629. There is every reason for the belief that the material will grade up to 22 lb., but the month's

output will be below 1,000,000 lb. Mohawk has not been troubled so much by the influenza epidemic as the other mines. It is rumored that the Mohawk has not kept its development openings sufficiently advanced. This is a mistaken impression. There are today openings for two years work in the Mohawk mine, all of them in a grade of material which will run better than 20 lb. per ton.

Victoria produced 170,000 lb. of crude copper during February, from which was secured 114,000 lb. of refined. This mine, like many of the other mines, suffered in the depletion of its working forces during the month owing to the general epidemic of sickness. At the present time Victoria is working 24 drilling-machines and this number could be doubled if more men could be secured. There is hope for the betterment in the situation at Victoria with the coming of spring. The long severe winter is hard on the people living in an isolated mining locality, but the summers are fine in Ontonagon county and the Victoria location is one of the beauty spots of the State. No further opening has been made at the 28th level. The cross-cut into the lode was 30 ft. and the faces indicate ore. The general run of the drifts to the south of the shaft are in a grade of material which is up to standard.

NEVADA

FLUORSPAR COMPANY OPERATES AT BEATTY.—DIVIDE NOTES.

BEATTY.—The Continental Fluorspar Co., a Delaware corporation, in the course of development work on claims in the Bare mountains, 5 miles south-east of Beatty, has shipped 14 carloads of material containing 90% calcium fluoride. Fluoride is used in blast-furnaces in the manufacture of steel, by glass factories, for the recovery of potash in cement plants, and for making hydro-fluoric acid for use in the manufacture of ceramic products. The purple spar is used as a pigment in making paint. During the past year the Continental company has employed an average of 25 men. The deposits are in fissure veins and on one claim, the Daisy, there is an outcrop 200 ft. long. On this claim a 6 by 8-ft. inclined shaft has been sunk 160 ft. in solid fluorspar. On the 85-ft. level two drifts, each over 100 ft. long, have been driven in fluorspar. At this depth the vein is 17 ft. wide. One-half mile west from this claim is another, the Fluoride, in which the company has sunk a 70-ft. shaft in material containing 92% calcium fluoride with a low silica content. It is thought further work may prove this vein to be a continuation of that in the Daisy. Four miles south is another group of claims in which there is a vein 150 ft. wide, with the outcrop visible for one-half mile. Little work has been done in this group, which contains commercial material. The company has erected at Beatty a plant for grinding the product to 150 mesh with a Sturtevant mill. Power is furnished by a Venn-Severin semi-Diesel engine using 27° oil. A 15-hp. Fairbanks-Morse hoist is used at the Daisy shaft and the ore is dumped directly into bins, from which trucks take it to the mill. No stoping has been done in any of the claims. The deposits are said to be unique in being free from sulphides. It is said that all other deposits contain lead, zinc, copper,

or other minerals in sulphide form, the fluorspar being secured as a by-product of concentration.

GOLDFIELD.—The funds raised by the Yellow Tiger through the assessment levied recently are to be used in further development of a silver mine near Stonewall mountain, 14 miles south of Goldfield, and none of the money, except that already spent in surface prospecting, is to be used in the Goldfield district. The mine at Stonewall has been worked for many years by Gordon M. Bettles, secretary for the Yellow Tiger company, and according to him, there is exposed 9000 tons of ore of an average value of \$21 per ton. He says: "There is in sight at least \$200,000 in recoverable ore." It is proposed to drive a 1600-ft. tunnel to cut the main vein at a depth of 1200 ft. The claims, a group of six, have been optioned by the Yellow Tiger for a stock consideration. Whatever the result of this venture, mining men consider that the chances for success are better than if the funds from the assessment were to be spent on the claims of the company at Goldfield. Development company stockholders are responding well to the call for a 3-cent assessment, according to officials of the company, who say they expect over \$85,000 to be realized. The levying of the assessment, coming at a time when official statements indicated milling on a good scale would be started soon, came as a surprise. A cross-cut on the 300-ft. level of the Silver Pick has been driven 55 ft. into the Mohawk vein in leased territory and indications are that the work is being done in an ore-shoot of medium grade. Assays of from \$7 to \$250 are being secured and it may develop that a find of more than ordinary importance has been made. The ore is in a previously unexplored part of the vein 300 ft. long and much additional work will be necessary before the value of the shoot can be determined.

DIVIDE.—Recent developments connected with the discovery of ore on the 500-ft. level of the Gold Zone and on the fifth level of the Tonopah Divide indicate that the orebody in the latter dips to the south-east. This has been a subject of discussion among engineers since rich ore was first found on the third level of the Tonopah Divide, as a dip in this direction would bring the orebody well into the Zone at a depth of from 700 to 800 ft. The south-east drift on the fifth level of the Tonopah Divide is reported to be in 35-oz. ore at a point 375 ft. from the cross-cut from the shaft, which, in connection with the position of the south-eastern ore-shoot on the upper levels, indicates a decided dip. The Gold Zone management plans to continue to a depth of from 150 to 200 ft., a winze being sunk in the newly found ore, and if conditions continue favorable the shaft will be sunk to 700 ft. The vein is 20 ft. wide and it is reported that the average value of the ore for this width is over \$15. Control of the Harmill, adjoining the Tonopah Divide, Gold Zone, and Alto, is reported to have been sold in New York. It is planned to deepen the 65-ft. shaft, and the company is negotiating to take over several prospects in outside districts. Among the developed prospects being considered is the Whitaker-Moon group in Montezuma, in which a promising lead-silver orebody has been developed. The new vein in the Alto has widened from 18 in. to 1 ft. and assays of as

high as \$45 have been secured from this width. The ore is a sulphide.

MANHATTAN.—The cross-cut being driven on the 800-ft., or bottom level, of the White Caps, is expected to cut the vein in April at a point 400 ft. from the shaft. There is reported to be a good demand for the arsenic being mined on the sixth level and the ore is being shipped through Tonopah. The ore is practically solid orpiment and realgar and the company receives for it \$32 per ton, f.o.b. Tonopah. It is planned to construct a flotation plant as an addition to the mill.

PIONEER.—The Mayflower has been closed because of the impossibility of securing an ample water supply for

owners continue confident that the payment will be made.

CACTUS.—Eight men are employed in constructing buildings at the Cactus Nevada and in extending the north drift on the 160-ft. level. A contract has been let for sinking the shaft an additional 100 feet.

UTAH

UTAH CHAPTER OF AMERICAN MINING CONGRESS ELECTS OFFICERS.

SALT LAKE CITY.—The Utah chapter of the American Mining Congress held its annual meeting March 8, and elected officers and directors for the ensuing year. A. G. Mackenzie, secretary and treasurer of the chapter, made



JANNEY FLOTATION MACHINES IN THE ARTHUR PLANT OF THE UTAH COPPER CO., AT GARFIELD, UTAH

the mill from the present source, a spring near the mine, according to J. B. Kendall, manager. A second reason for closing, according to Mr. Kendall, is that the oil used to drive the machinery at the mine and mill no longer can be secured and gasoline is too expensive. It is proposed to make changes in the plant that will permit the use of cheap fuel-oil and Mr. Kendall says the water-supply problem can be solved by using another source. The shaft of the Reorganized Pioneer is 560 ft. deep, or 110 more than when sinking was resumed. In a statement accompanying notice of assessment No. 2, W. J. Tobin, president, states that the \$15,000 indebtedness of the company has been liquidated. Since March 1 of last year 175 ft. of lateral work has been done.

TULE CANYON.—The holders of the option on the Ingalls mine have been granted a short additional time for making the first payment, which was due March 12. The

his annual report and some routine business was handled. At the membership meeting the following board was re-elected: Walter Fitch, H. M. Hartmann, Frank J. Westcott, C. E. Loose, Norman W. Haire, and J. B. Whitehill. The new members of the board are Samuel K. Kellock and J. M. Bidwell. After the membership meeting the directors met and elected George W. Lambourne, governor, to succeed Imer Pett.

PARK CITY.—The Judge Mining & Smelting Co. and the Daly West Mining Co. have declared dividends. The Judge company will pay on April 1, to stock of record on March 20, a dividend aggregating \$60,000, at the rate of 12½c. per share. Daly West will pay on April 1, to stock of record on March 20, a dividend aggregating \$37,500, at the rate of 15c. per share. The dividend to be paid by the Judge Mining & Smelting Co. is the first declared since April of last year; the one to be paid by Daly West

is the first to be paid in seven years. One orebody above the Judge 1200-ft. level has produced during the last two months on an average of \$1000 per day, with the value of the ore above \$100 per ton.

Shipments from the mines for the week ended February 27 totaled 2310 tons, a slight decrease from the output of the previous week, when shipments totaled 2400 tons. Ontario shipped 825 tons; Judge, 614 tons; Silver King Coalition, 493 tons; Daly West, 218 tons; Daly, 105 tons; and Naildriver, 55 tons.

The annual report of the Silver King Coalition Mines Co. shows there was mined during the year 1919 a total of 19,462 tons of ore, or a gross yield to the company of \$1,088,513 and to lessees \$6611. The contents included 528,328 oz. of silver, 14,587 oz. of gold, 10,862,687 lb. of lead, and 145,716 lb. of copper. From the gross yield deductions were made of \$521,214, cost of extraction; \$241,300, cost of reduction; \$63,599, for transportation; and \$6905, for construction work at the mine. It is estimated that the total assessed valuation of this property will be well over \$1,000,000.

EUREKA.—Nineteen mines in this district shipped 138 cars of ore during the week ended February 27, as compared with a total of 158 carloads for the preceding week. The Chief Consolidated had an output of 31 cars; Dragon Consolidated, 21 cars; Iron Blossom, 16 cars; Tintic Standard, 15; Grand Central, 11 cars; Eagle and Blue Bell, 8 cars; Centennial Eureka, 7 cars; Colorado Consolidated, 6 cars; Gemini, 5 cars; Mammoth, 4 cars; Bullion Beck, 3 cars; Victoria, 2 cars; Alaska, 2 cars; Swansea Consolidated, 2 cars; Gold Chain, 1 car; Ridge and Valley, 1 car; Empire Mines, 1 car; Rabbit's Foot, 1 car; Sunbeam, 1 car.

Since work was started through the Yankee shaft for the development of the May Day ground, at a depth of 1800 ft., a total of approximately 600 ft. of drifting has been done, and further work will be carried forward as rapidly as possible. Some fairly good ground has already been prospected in this section of the May Day territory. The new Tintic-Davis company is planning the erection of new machinery and other improvements. Arrangements have been made for an extension of the power line to the property and it is expected by early spring to be busy with the sinking of the main working shaft. Already a force of men is at work preparing for the machinery and teams are busy hauling the new equipment. Meetings were held at Provo, on March 11, by a number of mining companies controlled by the Knight and Loose interests. The Grand Central company declared a dividend of 4c. per share, which totals \$24,000, payable March 22. This brings the total dividends paid by this company to \$1,862,000.

ALTA.—The gross output of the Sells Mining Co. of Alta for 1919 was \$10,940, and the total expenses were \$35,080, leaving a net deficit of \$24,140. Alta Consolidated stockholders have received notice of a special meeting of the company to be held on March 22 for the purpose of considering and voting on the question of increasing the capital stock of the company from 600,000 to

1,000,000 shares. During the year 1919 the company's development consisted of 935 ft. of drifting, 380 ft. of raises, and 170 ft. of sinking. The installation by the Little Cottonwood Transportation Co. of a spur to connect with the bins at Tanner's flat is expected to considerably reduce the cost of transportation.

WISCONSIN

REVIEW OF FEBRUARY.

Firm prices for zinc ore, all grades, and lead ore higher in price than at any time in a year or more, failed to afford much incentive toward increased production during the month of February, in the Wisconsin field. The chief drawback was found in the labor situation. An acute scarcity of shovelers was complained of by all leading operators and diligent effort to supply the deficiency failed to secure relief. Coupled with this was a season of cold weather and heavy snows, and roads were in such abominable condition that supplies and ore moved with great difficulty. Producers removed from railroads were at times completely isolated. Open market quotations at the beginning of the month, ruled on a base of \$51 per ton. This level was advanced about mid-month, prime Western blende holding on a base of \$51 per ton, and premium-grade blende at \$54 per ton.

Lead-ore sellers held a distinct advantage all month, on account of a steady demand for ore at high prices. Offerings ruled steadily the first half of the month at \$100 per ton, or better. Toward the middle of the month offerings advanced to \$102.50 per ton, 80% metallic content. The last week in the month found the base held at \$105 per ton, with few producers showing a disposition to market. Production was rather under normal as the complete output of mill-feed for the month fell off considerably and with this went in relative proportion the recovery of lead ore, since most of the lead ore produced in the Wisconsin field is obtained as milling by-product. Should high prices for lead ore continue no doubt many small mining concerns will be engaged in mining lead the coming spring. The break-up is near at hand and the offerings for ore are a strong incentive toward an increased production.

Producers of carbonate zinc ore were confined to the mines of the New Jersey Zinc Co., in the Highland district, and these were not regular in their deliveries. The prices offered made a gain to \$40 for 40% zinc. Deliveries of zinc ore, from mines to reduction-plants in the field, and from mine to smelter direct, and lead ore, were made for February, by districts, as here given:

District	Zinc, lb.	Lead, lb.
Benton	8,478,000	478,000
Livingston	4,832,000	80,000
Galena	3,752,000	30,000
Cuba City	1,594,000	244,000
Hazel Green	1,214,000	140,000
Linden	580,000	.....
Highland	480,000	.....
Platteville	176,000	.....
Shullsburg	76,000	554,000
Total	21,182,000	1,526,000

Shipments of high-grade blende to the smelter were made for February as follows:

Company	Blende, lb.
Mineral Point Zinc Co.	4,490,000
National Zinc Ore Separators.	2,720,000
Wisconsin Zinc Co.	2,686,000
Block-House Mining Co.	176,000
Linden Zinc Ore Co.	174,000
Total	10,246,000

BRITISH COLUMBIA

DEVELOPMENT NEAR NEW HAZELTON.

VICTORIA.—The Provincial Minister of Mines has been in conference with the president of the Canadian Pacific company with the object of reaching some arrangement with the railway official by which a large tract of land on Vancouver Island may be thrown open for mineral location. This tract was given to the railway company as a consideration for building the Esquimalt and Nanaimo railway, the gold and silver rights being reserved. As practically any gold and silver that occurs over this area, so far as is known, is associated with base metals, under present conditions it offers no inducement to prospectors, and, as the company is not exploring the land, a large area of promising mineral land has been tied up. It is to be hoped that the Government and the company may be able to reach some satisfactory arrangement by which the land may be thrown open for location.

VANCOUVER.—It is reported that the Lucky Four, at the head of Wahleach creek, in the New Westminster division, has been bonded to the Guggenheim interests. A large body of low-grade copper ore occurs in a zone of altered sedimentary rock. The property comprises 12 mining claims.

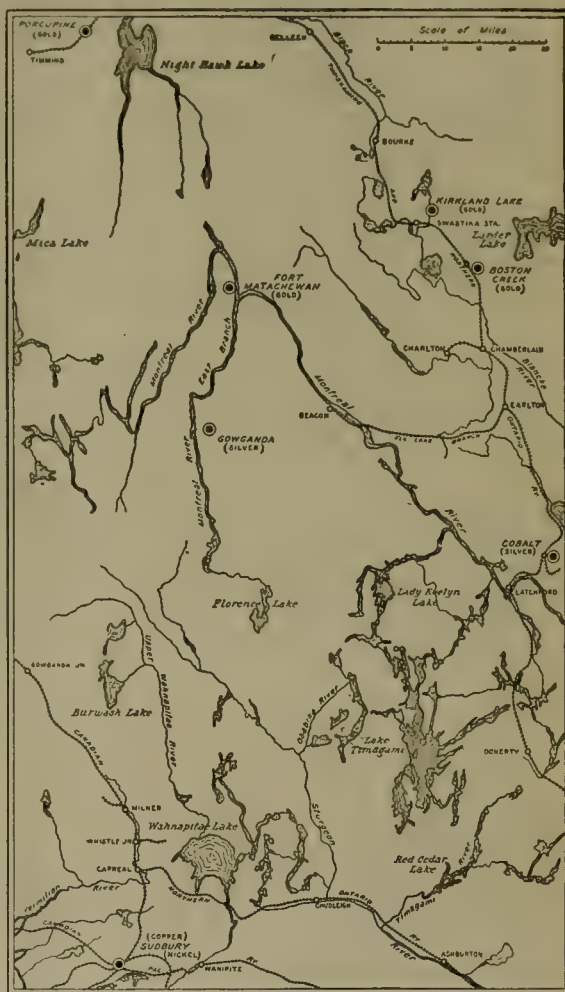
ANYOX.—It is rumored that the Granby Consolidated M. S. & P. Co. will build a large concentrating mill at its Hidden Creek mines, to treat ore that is too low grade for direct smelting. There is said to be a reserve of 10,000,000 tons of this class of ore; and, during the past year, the company has been experimenting with it in a 100-ton plant, erected for the purpose.

NEW HAZELTON.—On Hudson's Bay mountain there are a number of promising properties under development. The Mamie, under bond to Seattle capitalists, is attracting attention. J. D. Galloway, district engineer, reporting in 1917, said of this property that the ore-minerals disseminated through the gangue in bunches and stringers are zinc-blende and arseno-pyrite, together with a little chalcopyrite. The main metal in the ore is zinc, but the arseno-pyrite carries some gold. Some silver occurs with the zinc, but as a rule the silver content is low. The Victory and Empire groups, staked by the Simpson brothers, are under bond to the Skeena Milling & Mining Co., which has started building a concentrator. There is the Coronado group, also leased by the last named company, which is showing up well. It is considered one of the most promising properties on the mountain.

ROSSLAND.—The strike of the metal miners here is at an end. It lasted two days, being called as a result of

the company's decision to cease shipment of ore to the Trail smelter pending certain development work. The men decided to return after a conference with officials of the company.

TRAIL.—Ore receipts at the Trail smelter, Consolidated Mining & Smelting Co., totaled 5692 tons for the week February 15 to 21. Up to the latter date the smelter has received this year 53,534 tons, of which 2619 was concentrate and 50,915 ore. Of concentrate the Standard



MAP SHOWING MINING DISTRICTS OF NORTHERN ONTARIO

mine, Silverton, has contributed 1167 tons. The leading shipper has been the Sullivan mine, Kimberly, which shipped 19,709 tons of zinc ore and 834 tons of lead ore. During the latter part of February the Republic, of Slocan City, joined the list of shippers with a contribution of 19 tons.

SHEEP CREEK.—Two mine officials, Harold Lakes, superintendent for the Nugget Mines, Ltd., and E. V. Buckley, manager for the Queen Mining Co., had an unpleasant experience late in February. They were suspended for five hours in buckets on the aerial tramway of the Nugget mine while a severe snowstorm raged about them.

Normally the trip takes twenty minutes, but on the unlucky journey in question there were two forced stops, the last being for four hours over a 200-ft. canyon, where rescue by ropes was out of the question.

SANDON.—Recent development on the Noble Five mine, owned by James Dunsmuir and situated at Cody, has opened, on two or three levels, a 4-ft. shoot of ore whose existence was not suspected previously. The Noble Five has been subjected to deep development with good results. From the operating tunnel a vertical raise ascends, and from stations on this raise cross-cuts are run to the vein on various levels. Ultimately the workings of the Noble Five and those of the Reco, higher up, also owned by Mr. Dunsmuir, will be continuous. Extensive diamond-drill work has been done and it is figured that there is ten years stopage for the concentrator now being built. The fine-grinding floor of this plant will be equipped with Hardinge and Rogers mills. A battery of six Wilfley tables will be placed on the floor above, with two tables on the top floor. Rolls, jigs, classifiers, and flotation will be used. From its first crushing the ore, after being elevated to the bins, will be fed into the rolls, and then will pass to three sets of screens, from which the oversize will go to the jigs, an intermediate product to the upper tables, and the under-size to the lower tables. The tailing will be re-ground in the ball-mill, whose product will go to the classifier. There will be flotation equipment consisting of roughers and cleaners, the froth going to the lower tables for further separation. Lack of cars and other transportation delays has held back construction, but it is said that most of the machinery is in place and that the mill should be ready for its trial run early in the spring. The property is equipped with a 675-cu. ft. Rand compressor.

ONTARIO

KERR LAKE REPORT.—GOWGANDA NOTES.

COBALT.—During February the Kerr Lake mine produced approximately 100,000 oz. of silver, of an estimated value of \$150,000. Costs averaged a little under 50c. per ounce, and net profits for the month amounted to over \$100,000. The Associated Gold Mines of Western Australia, operators of the Keeley mine in South Lorrain, have bought 20 stamps now in the mill recently purchased by the Coniagas from the Trethewey. This equipment, together with a carload of cement for constructing a foundation for the proposed new mill together with other necessary building material, is to be transported at once to the property, and it is hoped to commence production by late summer.

The McKinley-Darragh will pay its regular dividend of 3% on April 1. Current net earnings are stated to exceed dividend requirements. The present surplus approximates \$500,000. Total disbursements by this company to date amount to 259% or \$5,754,163. The referendum taken by the various branches of the Union of Mine, Mill and Smelter Workers in Northern Ontario, for the purpose of deciding whether or not, in breaking away from the International it would be best to join the

'One Big Union', or organize a district union, resulted in a large majority in favor of joining the One Big Union. The vote is representative of the membership of the Union, but the latter comprises not more than 10% of the workers in the mines.

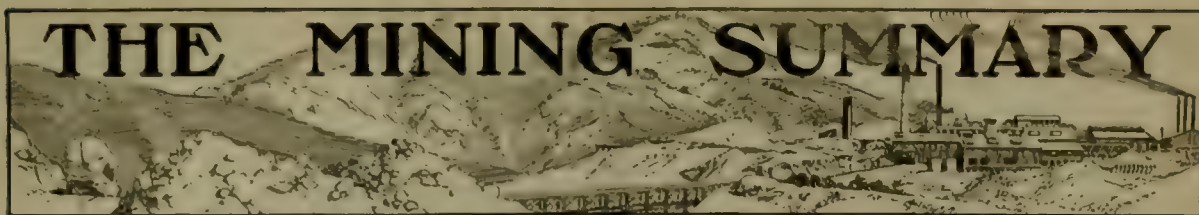
Harry Mills, Ontario Minister of Mines, makes the statement that in appointing a mining inspector to fill the vacancy on the staff of mining inspectors caused by the death last fall of A. H. Brown, he will select a returned soldier, keeping in mind the necessary qualifications. The Coniagas company is negotiating for the purchase of the Gamble-Thompson mining claims in the Gowganda district. The deal at present includes only an option to purchase. The Silver Bullion Mining Co. with property at Leroy Lake has purchased a \$30,000 mining plant formerly used on a mining property in Nova Scotia. The equipment is now in course of transportation to the property.

PORCUPINE.—The annual report of the Hollinger Consolidated for 1919 shows that year to have been the best in the history of the company. The recovery of gold was \$6,722,266, and other sources of income brought the total receipts up to \$7,063,099. Working expenses amounted to \$3,222,617, and net profits after deducting taxes, depreciation, and donations, were \$2,321,290. Of this, \$1,722,000 was paid in dividends and \$599,290 added to the surplus. The wages bill amounted to \$1,701,104. The number of tons of ore milled was 711,882, of the average value of \$9.75 per ton. The value of the ore-reserves was estimated at \$39,928,430, as compared with \$41,080,005 in 1918. The report makes public the news that the company has entered the oil-field by the purchase of the Herrington property of 3760 acres in Dickinson and Morris counties, Kansas, for \$115,195, the price including the sinking of a well by the vendors costing about \$35,000.

GOWGANDA.—The Trethewey will shortly make a second shipment of ore taken from the vein on the 108-ft. level, where the high-grade vein is widening and increasing in silver content. The Silverado, which is now employing 35 men, is obtaining satisfactory results and will shortly begin work on the Silverado Extension adjoining. Development will shortly be begun on the Bonsall claims, ore from which is now being sampled to determine the point where work will be started. The Kilpatrick Silver Mines, Ltd., has taken over the Kilpatrick claims next to the Miller Lake-O'Brien and begun operations. It will sink to the geologic horizon on which the Miller Lake-O'Brien has obtained rich ore.

SKEAD TOWNSHIP.—A good deal of interest is being taken in this area, adjoining the Boston Creek district, and many new companies are entering the field. The matter of transportation, however, presents a difficult problem. There is much activity in taking in supplies and machinery over the winter roads before the break up renders them impassable.

BOSTON CREEK.—The Miller Independence has completed its main shaft to the 500-ft. level and let a contract for cross-cutting to the main orebody. At the Peerless, formerly the Mondeau, a rich vein 5 ft. wide has dipped into the shaft below the 100-ft. level.



ALASKA

Hyder.—The fourth shipment of ore from the Premier mine, Salmon River district, has been made to the Tacoma smelter. The shipment amounts to 300 tons and the ore is reported to assay about \$275 per ton.—Development is proceeding on the Big Missouri.—The tunnel on the Bush mine is reported to be in high-grade ore. The same is true of the Forty Nine. A cross-cut tunnel is being driven on the Unicorn.—Up the Bear river the crew at work on the Lakeview mine is in ore.—The Indian Mines, Ltd., plans to resume development on its four claims situated on the west side of Cascade creek, opposite the Bush property. Development consists of three open-cuts on the outcrop and two tunnels. The open-cuts expose a well defined vein, which can be followed on the surface for about 2000 ft. The vein is quartz and appears to follow a wide dioritic dike which intrudes the greenstone schists. The minerals found include galena, sphalerite, and pyrite.—With the report that the old Portland Canal Tunnel Co. may be revived, interest is being manifested in properties of Glacier creek back of Stewart, B. C. The tunnel was an ambitious scheme started in 1912 to run 2000 ft. to tap at depth all orebodies of Glacier creek. An early opening of the Salmon River district is expected, the weather having been mild and much of the snow having already disappeared.

Juneau.—The Alaska Gold Mines Co. reports an operating deficit of \$277,481 for last year and, with its miscellaneous income deducted, a total deficit of \$275,128. This company's 1918 deficit was \$110,290.

A total of 738 ft. of development work was done in the company's property in the last quarter of 1919, consisting of the driving of man-way raises and bull-dozing drifts in connection with the opening up of new stopes. The mill was operated on a three-shift basis during the quarter. A daily average of 7528 tons was milled—the highest rate reached for any quarter since the mill has been in operation. The company's generating stations operated satisfactorily throughout the quarter and developed sufficient power for the operation of its mine, railroad, and mill, and an excess which was sold to other industries in the district. The labor situation improved somewhat during the quarter.

The town of Hope, situated on the Kenai peninsula, has been the scene of a silver-gold discovery that promises to develop considerable importance. The vein is said to be 6 ft. thick, the ore assaying \$77 per ton. A 3-in. stringer, it is said, assayed \$300 per ton.

ARIZONA

Jerome.—The main top orebody of the Jerome Verde Copper Co. has been cut on the 950-ft. level and the quality of the ore is said to be as good as that mined from above the 900-ft. level.

It is reported that the Bagdad Copper Co.'s mine in the Eureka district is being reopened. Twenty men are employed. A new road is being built and new machinery has been brought in.

Miami.—It is announced that the holdings of the Warrior Copper Co., which lie adjacent to the Inspiration Copper Co.'s property, have been sold to the Inspiration for approximately \$500,000. The Warrior Copper Co. was organized

several years ago and capitalized at \$1,600,000. Since organization it has produced intermittently.

CALIFORNIA

Allegghany.—The El Dorado Co. has placed a 10-stamp mill in commission on ore from the dump. Development of ground below the old levels is proceeding under the management of T. J. Flynn. The property is controlled by Nevada capitalists.

Brandy City.—The Brandy City Mines Co. has completed a new tunnel to carry the sluicing flume into which gravel will be hydraulicked from the banks. The monitors are hampered by water shortage and are unable to operate at full capacity. Late storms have somewhat improved conditions.

Lincoln.—Thirty sets of lessees are active in this district and shipping ore is exposed at several points. The Robert Maris lease on the Wilkinson has exposed a 10-in. shoot, sampling \$200 per ton. The shaft is down 50 ft. and a drift from this point is following a seam of rich ore. Silver predominates.

Masonic.—A. G. Cook and associates have purchased the Pittsburg-Liberty group for the reputed price of \$32,500. The first payment, 25% of the purchase price, has been made and the balance will be met in \$10,000 installments. Plans are being made for the comprehensive exploration of promising ground. The property was a good producer several years ago.

COLORADO

Mayday.—Avery & Brandiger, lessees on the Idaho, are shipping ore said to be worth \$6000 per ton. The ore is the La Plata sandstone and contains free gold and sylvanite.

IDAHO

Coeur d'Alene.—Recent development work at the Giant Ledge property on Granite creek, four miles east of Murray, has opened up an excellent vein, according to L. W. Jackson, consulting engineer. Development plans involving an outlay of \$100,000 have been made.—T. B. Cosgrove, manager and foreman of the West Hunter company, who is driving the West Hunter cross-cut through the American Commander ground, says that there is now eight inches of high-grade galena in the face of the cross-cut.—The Silverado mining property, which is developed with thousands of feet of underground work, has been leased to four Wallace men—William Fahle, Knute Rosedale, Oscar Johnson, and Emil Peterson. The property is near Osborne, and the lease includes a 50-ton concentrator built four years ago and said to be in good condition.

Galena ore in a body 8 to 10 in. wide has been found at a depth of about 1000 ft. in the property of the American Commander Mining Co., according to J. L. Martin. The vein has been penetrated for 8 ft. without reaching the wall.

MISSOURI

Joplin.—The Jupiter Zinc Co. is making satisfactory progress with its mine south-west of Galena, near Wyandotte station on the Southwest Missouri railroad, and a good body of zinc and lead ore is being worked at a depth of 80 ft. The shaft will be sunk deeper, as the field-shaft shows a big

orebody at 108 ft. It is said the field-shaft shows a 60-ft. face of ore, with a width of 40 ft. There is a mill of 125 tons capacity at the new shaft. A sludge department is being added to the mill.

The Oronogo Mutual mine, which recently resumed operations after a shut-down while improvements were being made, will begin sinking another shaft to supply ore to work the plant for a greater production. The company built additional tramways during the shut-down, connecting the mill and mine at a distant part of the lease.

MONTANA

Butte.—The Anaconda Copper Mining Co. is now reported to be actively engaged in spending \$1,500,000 in a systematic effort to eliminate mine hazards in all its properties. As a part of the plan, 11 new positions have been created. The new officials will be known as safety and ventilation engineers and will devote their entire time to training men to avoid accidents and in studying means to improve underground conditions. Many of the mines are now equipped with canvas air-pipes, which, it is said, make the mines cooler in some cases than they were ten years ago, despite increased depth.

NEVADA

Ely.—The Consolidated Copper Mines Co. is making a drastic cut in its forces. The present payroll is about 250 men, which, it is understood, will be reduced to about 90. The pumps will be kept working and enough men retained to keep the mine in shape. No explanation for this step has been offered by officials.

WASHINGTON

Spokane.—C. A. Coffin, who purchased from Walter Donner the lease on the Coyote galena property, north-east of Colville, last fall, has financed a syndicate that will commence operations when the snow is gone. The only necessary preparation for shipping is the building of a wagon-road one mile long. The mineralized zone is said to be 500 ft. wide and ore can be immediately mined with a steam-shovel. Two assays showed: 122 oz. silver and $4\frac{1}{2}\%$ lead, and 133.44 oz. silver and 26.31% lead. There is about \$100,000 worth of ore now ready to ship.

The Silver Mountain Mining Co., operating on the old Daisy mine, five miles east of Daisy, is having machinery hauled to the property for a 50-ton concentrator. Several good veins have been uncovered recently in the Daisy mine and the property is now looking well. About 25 years ago considerable ore was shipped. Philo Seely is in charge.

MEXICO

The Mexican plants of the American Smelting & Refining Co. have increased operations to about 90% capacity and barring unforeseen disturbances will this year, for the first time in five years, contribute net earnings to the company's treasury.

Pachuca.—Hugh Rose, consulting engineer to the Santa Gertrudis company, reports that by the latter part of this year the El Bordo group, comprising the El Bordo, Malinche, and El Cristo mines, should be producing at the rate of 40,000 tons of ore per month, and recommends that the Santa Gertrudis milling capacity should be increased to provide for the treatment of 60,000 tons per month to include 20,000 tons per month from the Santa Gertrudis mine. The reduced production from the Santa Gertrudis itself will have the effect of prolonging its life. The directors have approved and authorized this increase in the milling plant, and its construction at an estimated expense of \$300,000 will be commenced at once.

It has just been reported that 136 miners have not been accounted for in the El Dorado mine where fire broke out recently; 204 of the 340 men working in the shaft where the flames are raging have been accounted for.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Albert Burch has gone to Wallace, Idaho.

Arthur W. Jenks is in New York for a few weeks.

C. M. Weld has returned to New York from Brazil.

Ralph Arnold has returned from Washington to Los Angeles.

F. R. Weeks is examining mining properties in Utah and Montana.

O. C. Ralston passed through San Francisco on his way from Niagara Falls to Seattle.

K. S. Twitchell, recently at Nicosia, on the island of Cyprus, is now living at Los Angeles.

Joel A. Battle, recently with the U. S. Bureau of Mines at Washington, is now at La Paz, Bolivia.

W. E. Mitchell has been appointed general mine superintendent of the La Blanca at Pachuca, Mexico.

A. H. Fay has resigned from the U. S. Bureau of Mines to engage in consulting work as engineer of oilfields.

G. S. McKay has accepted a position with the Mina San Juan y Anexas, at Cusihiuriachic, Chihuahua, Mexico.

L. C. Trent is at the U. S. Bureau of Standards, at Washington, where he is conducting some important experimental work.

N. C. Sheridan, of Wallace, Idaho, has been appointed manager for the Snake & Opportunity Mines Co., at Hillsboro, New Mexico.

Jerome A. Hilbert has been appointed superintendent of the Blue Ledge mine of the Mexican Smelting & Refining Co., at Copper, California.

G. A. Denny has been appointed consulting engineer for the Transvaal & Rhodesian Estates, Ltd., Finsbury Pavement House, London, E. C.

H. Lipson Hancock, general manager for the Wallaroo & Moonta Mining & Smelting Co., in South Australia, sailed for Sydney on the 'Sonoma'.

R. W. Prouty, formerly with the Phelps Dodge Corporation at Morenci, has accepted a position with the Old Dominion Co., at Globe, Arizona.

Algernon Del Mar has gone to Sinaloa, Mexico, to undertake metallurgical work for the Metatas Mining Co. He expects to be away three months.

Walter B. Robinson, recently of Portland, Oregon, is now employed as engineer by the Mexican Smelting & Refining Co., at Blue Ledge mines, Copper, California.

Ralph Kerns has severed his connection with the Inspiration Consolidated Copper Co., and has accepted a position in the engineering department of the Phelps Dodge Corporation, at Douglas, Arizona.

James Heggie has severed his connection with the Consolidated Kansas City Smelting & Refining Co., of El Paso, Texas, and is now associated with the United Verde Extension Mining Co., at Verde, Arizona.

Obituary

Andrew Muir, one of the pioneer engineers of California, died, at the age of 82, at St. Paul, Minnesota. He was born in Ontario, Canada, and spent his early manhood in South America. He built the Bozeman and Muir tunnels on the Northern Pacific railroad in Montana and helped to build the old Santa Cruz narrow-gauge line in California. In 1872 he was in charge of the Alps mine at Pioche, Nevada.

THE METAL MARKET



METAL PRICES

San Francisco, March 16

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11.50
Copper, electrolytic, cents per pound.....	18.75
Lead, pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$142
Platinum, 10% iridium, per ounce.....	\$102
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	10.25
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 15—Copper is quiet and easy. Lead is very strong. Zinc is dull and erratic.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending
Jan. 9.....	128.00	77.62	Feb. 2.....134.37 83.83
" 10.....	127.00	75.00	" 9.....132.50 87.69
" 11.....	121.00	69.87	" 16.....132.10 85.72
" 12.....	121.00	70.00	" 23.....130.00 83.55
" 13.....	117.00	70.12	Mch. 1.....129.87 82.76
" 14 Sunday.....			" 8.....130.37 81.16
" 15.....	117.50	70.25	" 15.....121.90 72.14

Monthly averages

Date	1918	1919	1920
Jan.	88.72	101.12	132.77
Feb.	85.79	101.12	131.27
Mch.	88.11	101.12	...
Apr.	95.35	101.12	...
May	99.50	107.23	...
June	99.50	110.50	...

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Mch. 9.....	18.37
" 10.....	18.37
" 11.....	18.37
" 12.....	18.37
" 13.....	18.37
" 14 Sunday.....	
" 15.....	18.37

Monthly averages

Date	1918	1919	1920
Jan.	23.50	20.43	18.25
Feb.	23.50	17.34	19.05
Mch.	23.50	15.05	...
Apr.	23.50	15.23	...
May	23.50	15.91	...
June	23.50	17.53	...

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Mch. 9.....	9.50
" 10.....	9.50
" 11.....	9.50
" 12.....	9.50
" 13.....	9.50
" 14 Sunday.....	
" 15.....	9.50

Monthly averages

Date	1918	1919	1920
Jan.	6.85	5.60	8.65
Feb.	7.07	5.13	8.88
Mch.	7.28	5.24	...
Apr.	6.99	5.05	...
May	6.88	5.04	...
June	7.59	5.32	...

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920
Jan.	85.13	71.50	62.74
Feb.	85.00	72.44	...
Mch.	85.00	72.50	...
Apr.	88.53	72.50	...
May	100.01	72.50	...
June	91.00	71.83	...

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
Mch. 9.....	8.90
" 10.....	8.95
" 11.....	8.95
" 12.....	9.10
" 13.....	9.10
" 14 Sunday.....	
" 15.....	9.15

Monthly averages

Date	1918	1919	1920
Jan.	7.78	7.44	9.56
Feb.	7.97	6.71	9.15
Mch.	7.87	6.53	...
Apr.	7.04	6.49	...
May	7.82	6.43	...
June	7.82	6.91	...

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Average week ending
Feb. 17.....	80.00
" 24.....	80.00

Monthly averages

Date	1918	1919	1920
Jan.	128.06	103.75	89.00
Feb.	118.00	90.00	81.00
Mch.	112.00	72.80	...
Apr.	115.00	73.12	...
May	110.00	84.80	...
June	112.00	84.40	...

MONEY AND EXCHANGE

Edward N. Hurley, former chairman of the Shipping Board, discussing the new chartering agreement by which the Government cargo ships are to be operated says: "Our merchant fleet must not become concentrated in the hands of a few large steamship companies. If that should happen, these companies would soon find themselves facing difficulties similar to those that confront the Shipping Board with the only advantages favoring them, somewhat more flexible administration of affairs due to private ownership. These companies would have to establish agencies abroad, and develop large, complicated, but efficient operating organizations at home. This is something that cannot be done quickly even by a private company. Therefore they should be distributed among as many small companies as possible.

"At present close to 300 American steamship companies are organized, many of them operating American ships successfully in overseas trade. By September when the building program has been completed the Shipping Board fleet will consist of approximately 1900 steel ships of 11,000,000 tons. If these companies can be induced to buy an average of six ships each, we shall have our government cargo fleet almost disposed of. Small companies will operate the ships with that close, energetic, resourceful, individual clipper-day application so necessary for success, yet without notable increase in present operating organization. For they would continue to use brokers abroad until the more successful had earned money with which to get together fleets large enough to justify establishment of agencies of their own in foreign ports.

"Our merchant marine can succeed little better government-owned and privately operated than government-owned and government-operated. Passing of title must therefore be expedited as much as possible. Bankers and the investing public must help. Money immediately required will not be relatively large, and future payments will be mainly from earnings. For instance, if the world price on oil-fired cargo tonnage be today \$165 a ton and if 10,000,000 tons of this shipping be sold on a 20% first-payment basis, and the rest in ten years, only \$330,000,000 will be required. Even this \$330,000,000 does not have to be raised all at one time as it will take two years to dispose of this tonnage. Surely our finances are such that this sum can be taken out of the regular channels of trade without undue disturbance.

"Bankers and shrewd judges of investment possibilities will help as soon as they realize our merchant marine can succeed despite foreign competition to hasten education of investors in shipping matters, as well as to gain counsel and advice upon what terms will best facilitate the private buying of the fleet. The President and the Shipping Board have called together a committee of our leading bankers with Henry M. Robinson at their head. As Mr. Robinson understands both banking and shipping, I expect much practical good to result from this committee. Our reborn merchant marine will succeed in face of competition from abroad, partly because ocean freight rates and shipbuilding costs will remain high for five years, but mainly because of our merchant fleet's advantage in oil-firing. Cost of living will undoubtedly come down greatly during the next few years. This, however, will be because of increased production of life's essentials as a result of wiser spending of money and less waste of effort upon luxurious non-essentials, rather than because of the general decline in commodity and other values."

Foreign quotations on March 16 are as follows:

Sterling, dollars:	Cable	3.72
	Demand	3.70½
Franc, cents:	Cable	7.52
	Demand	7.50
Lire, cents:	Demand	5.61
Marks, cents		1.35

Eastern Metal Market

New York, March 10.

All the markets are dull and weak except lead and antimony and values have declined.

Copper is again lower and demand is almost negligible.

Tin values are following the highly erratic London market where speculation is rife. Buying here is confined to dealers and is small.

Lead is very strong and prices are higher. Supply is still inadequate.

Prices for zinc have again receded and buying has been light. The London market is a factor in this.

Antimony is strong and higher.

IRON AND STEEL

With production at the highest rate in more than a year and the prospect of further increase as spring comes on, the steel trade expects gradually to work out of the serious hamperings of recent weeks, says 'The Iron Age'. There has been no rush thus far on the part of the railroads to buy equipment, and the week has rather added to the evidence that the strained conditions in the industry are yielding.

A development of interest in the wire trade is the taking of orders by a large producer with the stipulation that the price will be that prevailing at the time of delivery, indicating the abandonment of the low prices of March 21 on wire products. Automobile manufacturers have cared little what they have paid for early delivery steel, as high as \$90 being reported for sheet-bars which in turn they have had rolled into sheets for car-bodies. At the same time a sale of sheet-bars is reported in the Chicago district at \$70.

Further signs appear of the reaching of the peak in pig-iron prices. An effort to advance foundry iron in eastern Pennsylvania to \$45 did not succeed and foundry iron is still available at \$40, Birmingham. There is much more inquiry for pig-iron for export, owing to the fact that it can be shipped to England for ballast with cotton at considerably less than recent freight rates and there is a chance of a fair movement if the exchange situation improves.

Exports of iron and steel in January were heavier than in December—360,000 tons against 254,000 tons. A considerable part of the movement, however, was to Japan and other countries not affected by adverse exchange conditions.

COPPER

There is almost no demand and values have further declined. Electrolytic copper for early delivery and up to June is quoted at 18.37½ to 18.50c., New York, the latter being the quotation of leading producers. That this could be shaded on desirable business is evidenced by the fact that on 500 tons for export yesterday 18.50c., New York, was quoted; export orders generally command a slight premium over domestic. Lake copper is quoted at around 18.50 to 18.75c., New York, depending on the delivery and the quantity as well as on the seller. While the market is at present weak and inactive, a better demand is confidently expected in the near future.

TIN

The highly speculative London market continues to be the predominant influence here. The feature this week has been the decided fall, almost collapse, of values there. Yesterday spot Straits declined £14 per ton from the day before and was quoted at £372 per ton, which contrasts with £411 a week ago and with £418 about two weeks ago. This movement has been up and down within these limits. Quotations for spot Straits in New York have followed these changes. The result has been that importers and dealers can do no reliable calculating and hence very little business for any position. The business that has been transacted has been between dealers with consumers doing little and apparently

not at all anxious. This would indicate that they are well supplied. On Thursday last week about 300 to 400 tons of futures was sold at around 63 to 63.25c., with the spot market dull at 62c., New York. Today spot Straits is quoted at 60.25c., New York, with futures at about 62c. The slump on the British market is based probably on the labor situation in the British steel market which is affecting the tin-plate output. Arrivals thus far this month have been 500 tons, with 5465 tons reported afloat.

LEAD

Conditions in this market are unchanged; if anything the market is stronger. Late last Friday the American Smelting & Refining Co. advanced its price another ¼c. to 9.25c., New York, or 9c., St. Louis, but the outside market was already higher. Today independent sellers and producers are asking 9.50c., New York, and 9.15c., St. Louis, as a minimum for spot and early delivery. The metal is very scarce especially for spot. What is regarded by some as a good sign is the fact that consumers are not anxious to buy futures and one large interest is of the opinion that lead will probably not go any higher but if it does the advance will be small and temporary. A short supply with good consumption is a brief description of this very strong market.

ZINC

Values have again receded in the past week and demand has been and is very light, whether for domestic or foreign consumption. This market has followed the fluctuations of the London market where quotations have for the most part steadily declined and have been also speculative. Due to advices from the other side on Monday a selling wave appeared and values fell to 8.37½c., St. Louis, but yesterday the market was firmer there and as a result prime Western here for early delivery up to July and in some cases into the third quarter was quoted at 8.50 to 8.62½c., St. Louis, or 8.85 to 8.97½c., New York. What business is being done is largely by speculators or dealers.

ANTIMONY

The market is stronger with wholesale lots for early delivery quoted at 12c., New York, duty paid.

ORES

Tungsten: The market is very quiet with some business done in low-grade ores at \$6 to \$6.50 per unit in regular concentrates. Other grades range up to \$15 per unit. There is no news as to the tariff question. One dealer predicts confidently that no duty can possibly pass the Senate.

Ferro-tungsten is quoted at 80 to 90c. per lb. of contained tungsten.

Molybdenum: Quotations are nominal in a quiet market at 75 to 80c. per lb. of MoS₂ in regular concentrates.

Manganese Ore: A large quantity of foreign ore has been sold recently for early and extended delivery but details are withheld. There are possibilities that more may be sold. The last quotation was 80c. per unit, seaboard, but this could be shaded on a desirable order. Imports in January are 21,463 gross tons against 47,504 tons in January 1919. The total for the seven months ended January 31, 1920, was 128,822 tons against 293,971 tons for the same seven months a year ago.

Manganese-Iron Alloys: Demand for ferro-manganese is quiet and values are firm. Domestic producers are quoting \$175, delivered, for third quarter and \$160 for last half. Very little spot alloy is available. For such as has been sold and is still obtainable \$200 is asked and obtained. Some British alloy for shipment in the last half is held at \$165, seaboard. About 21,000 tons of spiegeleisen is under negotiation for export. Domestic demand is light at \$57 to \$60, furnace.

Book Reviews

The ABC of Iron and Steel. Edited by A. O. Backert. Third edition. Pp. 363, ill., index. The Penton Publishing Co., Cleveland, Ohio. For sale by 'Mining and Scientific Press'. Price, \$5.

This is the best single book that we have seen covering the general features of the iron and steel industry. The principal part comprises 23 chapters, each discussing some particular branch or aspect of the industry and each written by an expert in that particular line. Thus the mining and transportation of iron ore, the manufacture of coke, and the manufacture of iron, steel, and the principal steel products, together with the processes used are all discussed in order. The text is accompanied by many illustrations, both photographs and diagrams. Appendixes contain statistics of the industry and a directory of iron and steel works in the United States and Canada, arranged both alphabetically and according to products. The principal changes made in the third edition as compared with the second, include bringing these appendixes up to date, the insertion of an entirely new chapter on malleable castings, and a great deal of new matter on the treatment of the rolling-mill industry. While the various chapters are so complete as to contain much new information for the expert, they are so clearly written as to form fascinating reading for the layman.

Complete Practical Machinist. By Joshua Rose. Twentieth edition. Pp. 536, ill., index. Henry Carey Baird & Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

It is 26 years since the first edition of this useful book appeared. The work has been considerably revised and enlarged for the new edition, and while the earlier editions were devoted almost entirely to the cutting-tools themselves, the present volume also discusses at considerable length the machine-tools in which the cutting-tools are used. The book is written for the practical machinist without technical education, but many technically trained engineers could also find it useful. The chapter-headings are as follows: Cutting Tools for Lathes and Planers; Cutting Speed and Feed; Boring Tools for Lathe Work; Screw-Cutting Tools; Lathe-Dogs; Turning Eccentrics; Hand-Turning; Drilling With the Lathe; Boring-Bars; Slotting-Tools; Twist-Drills; Tool-Steel; Taps and Dies; Vise-Work; Fitting Connecting-Rods; Milling-Machines; Tool Grinding; Marking Out Work; Machine-Tools; Precision-Lathe Attachments; Gear-Shapers; and Miscellaneous Attachments. There are also three short chapters at the end of the volume on calculation of the speed of wheels, etc., on setting slide-valves; and on repairing pumps. We are inclined to believe, if the book were entirely re-written, that more space would be devoted to such subjects as high-speed steel, grinding-machinery, and other relatively new developments in the industry. However, although perhaps not very well balanced, the book is a useful one.

Outlines of the Geology of Brazil to Accompany the Geologic Map of Brazil. By John Casper Branner. Bulletin Geological Society of America, Vol. 30, No. 2, June 1919. 149 pp. with geologic map and illustrations. This bulletin can be obtained from the Geological Society of America, 77th St. and Central Park, West, New York. Every geologist or mining engineer desiring to inform himself on the geology of Brazil should secure a copy of Prof. Branner's compendium. While, of necessity, this bulletin does not contain all known information as to the geology and mineral resources of the republic, yet it does contain the key to all

such information, as well as representing graphically, so far as the scale of the map permits, all that is known of the geological formations.

Probably no one is better posted than Prof. Branner on this subject, as he has been accumulating data since his first visit to Brazil in 1874, and has spent many years in geological research in that region. Moreover Prof. Branner is a Portuguese scholar, a very important matter, since that is the language of the country and much that has been written concerning it is in that tongue only. He is also the author of 'Geologia Elementar', a text-book in Portuguese written for the schools of Brazil.

The geology is treated under four main heads: (1) Stratigraphic geology, describing the various formations from the Archean to the Tertiary, (2) General and economic geology by States, (3) Metallic minerals, and (4) Non-metallic minerals.

Under stratigraphic geology the following great divisions of geologic time are recognized:

A. Archean. The rocks of this era consist of granite, gneiss, quartzite, marble, and crystalline schist. These cover a large area in eastern Brazil and the larger part of the country north of the Amazon, and are likewise exposed in some portions of western Brazil. It would indeed seem likely from an inspection of the map that the Archean or Brazilian complex forms the basement formation of the entire region and that it exists at not a great distance from the surface even where covered by later formations. In the Archean are found gold, copper, platinum, tungsten, mica, graphite, potash minerals, precious stones, and excellent building-stones. Since the Archean is so wide-spread in Brazil, it would appear reasonable to conclude that many deposits of the above-mentioned economic minerals await future discovery; but considering the depth of surficial decomposition products, the large areas of virgin forests and the lack of means of communication, such discoveries will probably be spread over a long period of time.

B. Early Paleozoic. This group of rocks cannot be clearly defined for lack of stratigraphic data. No fossils have been found in any of them, but for purposes of discussion, the author places the top of the Archean at the base of the quartzite called itacolumite in Minas Geraes. The rocks vary from soft clay-slates to the hardest of quartzites. Economically the Early Paleozoic contains most of the profitable gold-lode mines and it is the indirect source of the gold found in the old placers. This series likewise contains the great iron (itabarite) and manganese deposits, recently investigated by Harder and others. Some investigators also consider this series as the original source of the diamonds and other precious stones. Without going into details, it is evident that the Early Paleozoic of Brazil is of the greatest economic importance and of the highest scientific interest.

C. Silurian. The oldest known fossils, found in Brazil in the States of Amazonas and Pará, are Silurian. The rocks are marine sediments, mostly thin-bedded sandstones.

D. Devonian. In the Amazon region the Devonian rocks are white and yellowish sandstones and black and reddish shales; in Paraná and southern São Paulo, conglomerates, sandstones, and shales; and in Bahia, the Caboclo shales of Branner are supposed to be Devonian. Economically the conglomerates of Paraná are supposed to be the source of the diamonds of that State. In Bahia the Caboclo shales are available for the manufacture of portland cement.

E. Carboniferous. All the Carboniferous rocks of Brazil belong to the Upper Carboniferous. In the Amazon region the Carboniferous rocks are shales, sandstones, and limestones, the last containing marine shells. No coal-bearing beds have been found in them. The Bahia beds are pinkish quartzites, sandstones, and conglomerates from which carbonades and diamonds are derived, and it is considered likely that these beds are simply the northern extension of

the diamond-bearing beds of Minas Geraes, although in neither state is the Carboniferous age of the diamond-bearing series as yet certainly determined.

F. Permian. The Permian rocks comprise nearly all kinds of sediments and are remarkable in containing, in the Lower Permian, beds of glacial origin. Permian rocks cover a wide area, extending from Maranhão south to Minas Geraes and continuing south in a narrower area. Economically the Permian contains coal beds in Paraná, Santa Catharina, and Rio Grande do Sul; and here too belong the Iraty bituminous shales of the southern states. The limestones are wide-spread and are likely to be of national importance in the manufacture of cement. It seems quite possible that some of the important occurrences of diamonds in Brazil are in glacial beds at the base of the Permian.

G. Triassic. The Triassic rocks are soft reddish sandstones, usually horizontal, but more or less faulted and intruded by sheets and dikes of diabase. They cover large areas in Maranhão and in central, western, and southern Brazil.

H. Cretaceous. The Cretaceous formations cover large areas. Economically the abundant limestones are available both for building-stone and portland cement.

I. Tertiary. The Tertiary beds comprise both marine sediments, brackish-water and fresh-water deposits. Economically the coastal belt of Tertiary sediments from Bahia northward are likely to be valuable for underground water. At several places in the States of Bahia and Alagoas, the Tertiary beds include lignites and bituminous shales, and this is likewise the case with the lake deposits of Minas Geraes and São Paulo. These shales were formerly used at Taubaté for the manufacture of gas. Clays for the manufacture of bricks, tiles, sewer-pipes, and common pottery are abundant.

General and Economic Geology by States. Under this head are given many details of the geology as well as bibliographies relating to each State, these descriptions comprising the larger part of the bulletin.

Metallic Minerals. Under this head the following are briefly referred to: Iron, gold, silver, copper, zinc, lead, tin, manganese, nickel, chromium, platinum, palladium, aluminum, tungsten, mercury, and molybdenum. Of these iron, gold, and manganese only are known in commercial quantity.

Non-metallic Minerals. Under this head coal, lignite, and peat, petroleum and oil-shale, asphalt, building-stone, marble, limestone, gypsum, anhydrite, kaolin, clay and fullers earth, glass sands, asbestos, talc, mica, salt, nitre, graphite, bauxite, monazite, zirconia, phosphates, diamonds, and other precious stones and carbonades are mentioned. Of these only the following are as yet known to be in commercial quantity: Coal, lignite, and peat, oil shale, granite, building-stones, marble, limestone, gypsum, potters clay, glass sand, talc, salt, nitre in caves, bauxite, monazite, zirconia, phosphate, diamonds, and carbonados.

Under the head of mining laws it is stated that mineral deposits go with the soil, whether that is owned by the State or individuals.

H. W. Turner.

The publication of a new and revised edition of the 'Prospector's Field Book and Guide' is announced. The book originally written by H. S. Osborn has been re-arranged and enlarged by M. W. von Bernewitz, formerly assistant editor of the 'Mining and Scientific Press', and will appear about March 20. Those familiar with the former work, and acquainted with the reputation of Mr. von Bernewitz will be glad to learn of this revision. A substantial flexible binding will add to the utility of the book. Henry Carey Baird & Co. are the publishers and the price is \$3. A copy can be had from the Book Department of the 'M. & S. P.'

Recent Publications

The Porcupine Gold Placer Districts, Alaska. By Henry M. Eakin. Bull. 699, U. S. Geological Survey, 1919. Pp. 29, ill., maps.

Experiment Stations of the Bureau of Mines. By Van. H. Manning. Bull. 175, U. S. Bureau of Mines, 1919. Pp. 106, ill., index.

Metal Resources of Alaska. Report on Progress of Investigations in 1917. By G. C. Martin and Others. Bull. 692, U. S. Geological Survey, 1919. Pp. 400, maps, index.

Gold, Silver, Copper, Lead, and Zinc in Nevada in 1918. Mines Report. By V. C. Heikes. I:12, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1918. Part I. Pp. 48.

Deposits of Manganese Ore in Southeastern California. By Edward L. Jones, Jr. Bull. 710-E, U. S. Geological Survey, 1919. From Contributions to Economic Geology, 1919. Part I. Pp. 24, maps.

Deposits of Manganese Ore in Costa Rica and Panama. Papers by Julian D. Sears. Bull. 710-C, U. S. Geological Survey, 1919. From Contributions to Economic Geology, 1919. Part I. Pp. 11, maps.

Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1918. Mines Report. By James M. Hill. I:11, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1918. Part I. Pp. 5.

Stratigraphy and Correlation of the Devonian of Western Tennessee. By Carl O. Dunbar. Bull. 21, State Geological Survey, Tennessee, 1919. Wilbur A. Nelson, State Geologist, Nashville, Tenn. Pp. 127, ill., diagrams, maps.

Oil in the Warm Springs and Hamilton Domes, near Thermopolis, Wyoming. By A. J. Collier. Bull. 711-D, U. S. Geological Survey, 1920. From Contributions to Economic Geology, 1919. Part II. Pp. 13, ill., map, table.

Removal of the Lighter Hydrocarbons from Petroleum by Continuous Distillation, with Especial Reference to Plants in California. By J. M. Wadsworth. Bull. 162, Petroleum Technology 45, 1919. Pp. 162, ill., diagrams, index.

Bibliography of the Metals of the Platinum Group.—Platinum, Palladium, Iridium, Rhodium, Osmium, Ruthenium—1748-1917. By Jas. Lewis Howe and H. C. Holtz. Bull. 694, U. S. Geological Survey, 1919. Pp. 558, index.

A Preliminary Report on the Mining Districts of Idaho. By Thomas Varley, Clarence A. Wright, Edgar K. Soper, and Douglas C. Livingston (in co-operation with the University of Idaho). Bull. 166, U. S. Bureau of Mines, 1919. Pp. 113, map, index.

A Catalogue of the Mesozoic and Cenozoic Plants of North America. By F. H. Knowlton. Bull. 696, U. S. Geological Survey, 1919. Pp. 815, table. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 60 cents.

Electrodeposition of Gold and Silver from Cyanide Solutions. By S. B. Christy. 171 pp., 8 pl., 41 figures. Bulletin 150 of the U. S. Bureau of Mines, 1919. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 25 cents.

The Copper Deposits of Ray and Miami, Arizona. By Frederick Leslie Ransome. Professional Paper 115, U. S. Geological Survey, 1919. Pp. 192, ill., maps, diagrams, index. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 75 cents.

The Sunset-Midway Oil Field, California. Part II. Geochemical Relations of the Oil, Gas, and Water. By G. Sherburne Rogers. Professional Paper 117, U. S. Geological Survey, 1919. Pp. 100, maps, index. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE LARGEST GYRATORY CRUSHER

The largest crusher in the world was built by the Traylor Engineering & Manufacturing Co. at its plant at Allentown, Pennsylvania. Some of the features are given here.

There was nothing startling in building this enormous machine, except the fact that it weighed more than 800,000 lb. and was completed in ninety working days, a feat in crusher-building made possible by the competent organization that H. L. Miller, general manager, has built up. He had kept in close touch with the modern trend of quarry-



Traylor 60-in. Gyratory Crusher

operation, had seen the need for the 'largest crusher in the world' coming for some time, so when it arrived he was ready to take the order and guarantee a delivery that would have been impossible, except for his foresight in equipping the new shops with machine tools and cranes capable of handling the parts of a crusher even bigger than the 60-in. 'Bulldog' gyratory. The following figures give an idea of the size of the machine:

Part	Weight, tons
Shaft complete with crushing-head.....	65
Middle shell	51
Top shell	50
Bottom shell	48
Spider (Hewes type)	29
Eccentric with cut-steel main gear.....	12

There are features embodied in the design of the 'Bulldog' gyratory crusher that make it practicable to build

crushers of even greater capacity than the present 'largest crusher in the world'.

The most essential part of any gyratory crusher is the eccentric, for here the power is applied that does the crushing, therefore the bearing pressures are very high. To overcome the high pressures in such crushers as the 60-in. and larger type, an eccentric of extra size is needed; one that has a positive means of lubrication, as well as greater proportional bearing area than other eccentrics. To keep the eccentric bearing pressure within safe limits, it required an eccentric over 8 ft. long and 45 in. diameter, having 9900 sq. in. of bearing surface for the 60-in. gyratory.

All 'Bulldog' eccentrics are fitted with a self-aligning journal bearing, which is loosely held to the shaft and around which the eccentric rotates.

This journal absolutely prevents any binding in the eccentric from any cause, thus greatly reducing the friction in the same. To efficiently lubricate the eccentric under all possible working conditions, a fully submerged pump of the gear type attached to and operated by the gyratory movement of the eccentric-journal bearing is used. This pump forces the lubricant up through the inner eccentric bearing to an oil channel at the top, thence it returns to the pump by way of the outer eccentric bearing; a portion being diverted to the main countershaft bearing and the cut-steel gears by means of which the eccentric is rotated.

As the gears run in a continual bath of oil, a quiet and easy-running machine is assured. The Hewes spider is used in all 'Bulldog' crushers to support the shaft at the top which carries the crushing-head. It is one of the features that made possible the 60-in. crusher.

The Hewes spider, like many other great inventions, is simplicity itself, for, unlike other gyratory crusher spiders, with their massive and useless spider ring, it consists only of an arched beam of box section, having the ends machined to a taper and a hub at the centre bored out to receive the all-steel shaft suspension. The tapered ends of the spider fit into pockets or recesses provided on either side of the top shell or section of the crusher, and when once they are drawn down into the pockets, metal to metal, by the extra large holding-bolts, the spider virtually becomes a part of the top shell.

Being of the low-arch type, it is possible to suspend the shaft at the point of no gyration, which is within the confines of the pockets, thus preventing any possible bending or twisting of the spider. This feature, combined with the great strength, light weight, and ease in handling, makes the Hewes spider one of the most notable improvements that has ever been brought out in gyratory crusher design.

The shaft, that all-important part of a gyratory, is shorter and 100% stronger in the 'Bulldogs' than in other makes of gyratory crushers. It is bend-proof in other words. Owing to its great strength a much higher proportion of the power used is consumed in actual rock-breaking than in other gyratory crushers, resulting in a greatly increased capacity with a smaller power consumption per ton of material crushed.

CONSTANT POTENTIAL CHARGING EQUIPMENT FOR AUTOMATIC CHARGING OF MINE-LOCOMOTIVES

For the automatic charging of mine-locomotives having Edison storage batteries the new C-H charging-panel shown in the accompanying illustration has been designed by the Cutler-Hammer Mfg. Co., of Milwaukee. It may be connected to a 250 to 275-volt direct-current circuit, since this is the service available at most mines. The equipment consists of a slate panel supported by a floor-type mounting-frame having the charging resistance self-contained. A



Mine-Locomotive Charging-Panel

sheet-metal roof protects the charging resistance and the magnetic switches on the panel from mine drippings. The switch equipment on the front of the panel consists of a main-line knife-switch with renewable fuses, magnetic main-line contactor, voltage relay, and shunt trip-relay.

The main-line contactor, which connects and disconnects the battery from the line, is controlled through the voltage relay and the shunt trip-relay. The former prevents it from closing unless the line voltage is of sufficient value for charging, and causes it to open if the power fails or the line voltage drops below a predetermined value, thereby guarding against the batteries discharging back into the line. On restoration of the power after a power failure the main-line contactor automatically re-closes, and the charge is continued. The shunt trip-relay is connected to the ampere-hour meter on the locomotive and when the battery is fully charged the ampere-hour meter will energize the relay, which in turn causes the main-line contactor to open and disconnect the battery from the line. This relay also opens the contactor should the line voltage become too high. Thus the voltage and shunt trip-relays permit charging only when normal conditions prevail on the line; that is, the supply voltage must lie between the limits for which the two relays are set.

The Hauck Manufacturing Co., of Brooklyn, New York, has issued bulletin No. 119, which illustrates and describes in detail the many different types of oil burners manufactured by the firm. The book has numerous pictures showing the practical application of the Hauck burners to various types of furnaces.

COMMERCIAL PARAGRAPHS

H. A. Linch, engineer for The Dorr Company, is on his way to South America, where he will visit Peru, Chile, and Bolivia. He can be reached care of the Hotel Londres, Antofagasta, Chile.

Bulletin No. 425 has just been issued by the Denver Fire Clay Co. It describes the company's entire line of muffle-type assay-furnaces, including those fired by oil, gas, gasoline, and coal or coke. It is an attractive and comprehensive publication.

R. S. Webber, who has been in the Michigan copper region the past three months for the Ingersoll-Rand Co., was promoted March 1 to take charge of the company's interests on the Gogebic Range, with headquarters at Ironwood, Michigan.

Booklet 121 has been prepared for the convenience of those who wish to see at a glance the styles and capacities of air-compressors built by the Sullivan Machinery Co. No attempt at description has been made; and the details shown in the tables are merely the principal dimensions and power requirements. A complete bulletin is issued, descriptive of each type, and any one, or all, will be sent the prospective purchaser upon request.

It is a known fact to many mining men that a considerable amount of lubricating material is wasted, particularly where common black oil is used for lubricating mine-car wheels. O. S. Newton, general superintendent of the Sunday Creek Coal Co., after investigating the apparent antagonism of mining men against high-grade semi-liquid lubricants, found that it is due largely to the lack of efficient methods of applying these lubricants. He therefore devised an oiling nozzle which renders it very easy to apply the lubricants to the car wheels. This device is of great simplicity and its use eliminated the waste material, no matter whether grease or oil is used. The Wolf Safety Lamp Co. has undertaken the manufacture of this device and will distribute it along with its line of mine lamps.

The following pointers on the use of wire rope appear in 'Leschen's Hercules', published by the A. Leschen & Sons Rope Co. A frequent cause of sudden wire-rope breakage is overstrain, and the best rope produced can as surely be overstrained as an inferior rope—not so easily or so soon—but it can be. There is a point of stretch in a rope called its elastic limit. Up to that point a rope will stretch and upon release from strain will so completely recover that no permanent set is appreciable. The handling of loads within the elastic limit of a rope may be repeated again and again, but should the strain be sufficient to stretch the rope beyond that limit even once, a part of the steel's vitality is gone and it becomes a set or a dead rope, and, even though sudden breakage may not immediately follow, early deterioration begins. The presence of brittle wires in a failing rope usually points to overstrain.

'Crucibles—Their Care and Use' is the title of Booklet No. 190-A, issued by the Joseph Dixon Crucible Co., who will be glad to supply a copy to those interested. Many refinery men do not fully appreciate the importance of keeping and handling their crucibles in a manner which will ensure the greatest number of heats with the least danger of accidents. The importance of the subject seems to be underestimated, and crucible users will find it to their advantage to give the matter more thought and attention, and instruct their furnace-men, melters, and others accordingly. As any defect in, or accident to, a crucible is an exceedingly annoying as well as an expensive matter, and as such occurrences are in most cases due to improper or careless methods in the annealing or handling of crucibles, the suggestions in this booklet should prove valuable, as they are the result of long experience and the best thought and knowledge on the subject.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Dewey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N.Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MARCH 27, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	439
THE GREATEST GOLD MINE	441

The New Modderfontein at Johannesburg in South Africa. Size of the property and extent of its ore-reserves. Grade of the ore and cost of production. Recent performance of the mine. Value of the stock as an investment.

THE GREAT DISILLUSION

441

Norman Angells 'Great Illusion' and the false hopes it stimulated before the recent war. 'Economic Consequences of the Peace', by J. M. Keynes. His attack on the treaty of peace. A highly rhetorical onslaught. A Carthaginian peace and a Pyrrhic victory. Financial clauses of the treaty. The claims against Germany and the impossibility of collecting them. The proposed international loan to the enemy countries. German exploitation of Russia. The League of Nations.

ARTICLES

THE ORE DEPOSITS OF MEXICO—II

By S. J. Lewis..... 443

Deposits in the sedimentary rocks. Contact deposit at Barreno. Three stages are distinguishable. Ajuchitlan. Mineralization by replacement. Origin of antimony ore in Santa Maria mines.

MINE-SAMPLING

By William Huff Wagner..... 451

Importance of current sampling. Scheme of sampling stopes; development workings. Method of performing sampling operations. Recording. Assay and stope-maps. Symbols.

DISCREPANCIES IN WEIGHING BULLION

By Harry R. S. Wilkes..... 454

Methods of pouring bullion. Reasons for discrepancies between mine and mint weights. Disagreement probably only apparent.

A MODIFICATION OF HORWOOD'S PROCESS FOR TREATMENT OF COPPER-ZINC ORES

By H. L. Hazen..... 455

Separation of sphalerite from sulphides of copper. Horwood's process. As a modification copper minerals may be oxidized by roasting and then leached. Final separation by flotation. Result of actual tests. Advantages.

THE FIRST MINERS AND THE FIRST CIVILIZATION

By Grant H. Smith..... 457

A glimpse into antiquity. The New Stone Age. Metal mining by the Egyptians in 4000 B.C. Highlights of Egyptian civilization.

DISCUSSION OF FLOTATION AT THE IDAHO SCHOOL OF MINES

459

Grinding for flotation. Ball-mills are predominant. Testing ores. Microscopic investigation. Field for further experiment. Handling flotation concentrate at the smelter.

NOTES

VOLATILIZATION IN ASSAYING

By Frederic P. Dewey..... 458

DEPARTMENTS

REVIEW OF MINING 461

THE MINING SUMMARY 469

PERSONAL 470

OBITUARY 470

THE METAL MARKET 471

EASTERN METAL MARKET..... 472

INDUSTRIAL PROGRESS 473

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.



T. A. RICKARD, - - - Editor

AN International Mining Convention will be held at Seattle on April 7 and the three following days. This convention is organized under the auspices of the Puget Sound section of the American Institute of Mining and Metallurgical Engineers and the Seattle Chamber of Commerce and Commercial Club.

ON another page we publish the second of a series of articles on the ore deposits of Mexico, by Mr. S. J. Lewis, a mining geologist thoroughly familiar with his subject. It will be noted that he illustrates his text with numerous drawings explaining the structural relations of the orebodies. These we believe will be appreciated by the men in charge of mines, in Mexico particularly but elsewhere also, because they give graphically the information most useful for aiding intelligent exploration.

WE are delighted to publish the brief, but deeply suggestive, article by Mr. Grant H. Smith on the beginnings of mining and of civilization. The fascination of a sketch such as this will send some of our readers to the nearest library, to plunge into the writings of Flinders Petrie, J. H. Breasted, and Gaston Maspero. In days like these when things are so much out of gear there is equanimity to be found in reading about men and mines in days so far detached from our existing turmoil. Someday somebody will be writing about our upsets of today as if they were mere thank-you-ma'ams on the road to progress.

IN our issue of December 13, 1919, we published the text of an address delivered by Mr. George L. Nye, as special counsel for the American Mining Congress, at the St. Louis convention of that Congress. In the course of Mr. Nye's arraignment of Minerals Separation, Ltd., he mentioned Kindersley and Pusch, and said they were understood at that time to have been agents of the German metal trust. Our attention has been drawn to the falsity of this reflection upon the loyalty of Sir Robert M. Kindersley and Mr. Emil Pusch. The former is a native-born Englishman and the latter, who is of Russian origin, has been a naturalized Englishman for many years. Both of them are, and have been for many years, members of the well-known firm of Lazard Brothers & Co. of London, Paris, and New York. Sir Robert is a governor of the Bank of England and the governor of the Hudson's Bay Co. During the War, he was the head administrator of the War Savings Bureau for all

England. Mr. Pusch was appointed a member of the British Mission to Russia and acted as such, and the loss of his two sons—officers in the British army—attests his devotion to the Allied cause. We regret the publication, even at second-hand, of any reflections upon their loyalty to their own country or to the Allied cause.

HORWOOD'S method of preferential flotation has been applied successfully to the lead-zinc ore of Broken Hill, in Australia. In this issue Mr. H. L. Hazen describes the results obtained in tests upon a copper-zinc ore in California, using a method that is a modification of the one devised by Mr. E. J. Horwood in 1912 and described by Mr. Allan D. Rain in our issue of October 7, 1916. Mr. Hazen recovered 37.6% of the copper as cement and 40.1% more copper in a product low in zinc. His zinc concentrate assayed 55.8% zinc and contained 54.6% of the zinc in the copper-zinc ore, not counting the further recoveries of copper and zinc concentrates to be made from the middling when returned for re-treatment in the flotation machine.

ACCORDING to the 'Neue Zürcher Zeitung', fine gold has been changing hands in Germany at the rate of 67,000 marks per kilogramme, as compared with a mint value of 1395 marks before the War. This measures the financial collapse of Germany. In the bazaar at Aden, gold sovereigns have sold for 37 shillings. At Rangoon, the customs authorities seized 2500 sovereigns and 3000 American \$20 gold pieces that were imported illegally on the steamship 'Hongmoh'. As regards the actual price of silver in London, Samuel Montagu & Co., to whom we owe the preceding data, state that it is probable that the extent of the premium on the currency pound is of more importance than the relation between the supply and demand for silver because the price of gold is an index of the American exchange, which establishes the par between the price of silver in New York and London.

INTELLIGENT mining under most circumstances requires systematic current sampling of working-places. There will be, of course, a varying degree of refinement, depending upon the width and extent of the orebodies and the character of the vein-matter and of the country-rock. Sometimes it is possible to distinguish definitely by appearance between material that should or should not be broken, or that should or should not be sent to the surface, even though breaking cannot be avoided.

More frequently assays are necessary. Even if it be not essential to maintain a fixed grade for shipment there is always a line somewhere beyond which 'rock' ceases to be 'ore', that is, too low-grade for profitable exploitation. Selective mining must be employed; and the guide for efficient selective mining is adequate sampling of doubtful blocks and prompt assay-returns. We have known instances where the stope-samples were considered of so little importance that they were set aside in the assay-office, so that when the results were finally reported nearly a week had elapsed after the samples were taken; in the meantime work underground had been suspended or inconvenienced; or perhaps the shift-boss had guessed at the grade and the material had either gone as waste into the filling or was already well on its way to the smelter. There must be dispatch from the time the sampling is done until the result is entered in the notebook of the man directly in charge of the stope being worked. This is one of several excellent points in the scheme of sampling practised by the North Butte company, as described on another page by Mr. William Huff Wagner, who, prior to entering the service of the Government, was geologist and engineer to that company.

RETURN of enemy-alien property vested in the Public Custodian is raising interesting problems in South Africa, as in the United States. The Custodian of Enemy Property in South Africa and the Public Trustee of the United Kingdom together hold large blocks of various gold-mining shares, a small part of which has been sold, by arrangement with the Custodian, to 'friendly' shareholders. In most cases, however, no such transfer has been effected. The Johannesburg correspondent of the 'Financial Times' states that a pronounced weakness in the quotations for the two Modderfontein mines is due to the fact that "it is no longer possible to deal with the large enemy holdings of these two companies". The South African Custodian has shown an inclination to be lenient with the individual possessions of interned enemy subjects, because there was no seizure of Britishers' property by the authorities when it remained in the possession of the Transvaal and Free State during the time of the Boer war. The richer mines, however, were worked for the benefit of the South African Republic of Krüger and his friends. In any event, it is a fact that Section 7 of the Peace Proclamation provides for the return of the assets of German nationals resident or domiciled in the Union of South Africa at the outbreak of the War, on proof of residence and title, subject to the Custodian's fees. No less than 66,500 shares, or one-fifth the capital, of the New Modderfontein passed into the hands of the Custodian; and during the War the market-value of the stock rose from £12 to £35 per share. Obviously it was fortunate for the German holders that their stock was locked up for the five years during which most of them were likewise locked up in the internment camp at Maritzburg. They could not sell their shares while in duration and now they resume possession of their property at a trebled valuation, plus the dividends that have accumulated. A sliding-scale tax has been suggested on

this unearned increment, but only as an expression of goodnatured humor. The directors are being blamed by some people for not having made a deal for the purchase of the stock while it was in the Custodian's keeping. Now it is too late and there is a fear that the liberated Germans will proceed to take advantage of the high price, thereby spoiling the market. That is why the quotations are low. War hath its humor no less than peace.

A UNIQUE phase of the labor problem in South Africa is an unwritten law known as the 'color bar'. By its operation natives are excluded from the performance of 'skilled work' at the mines; and the tendency in recent years has been so to extend the definition of skilled work that there is no chance whatever for the native to improve his status or his pay, no matter how skilful or efficient he may become. This has come from humoring the less competent of the whites who have bluffed the operators by threats of a strike. It appears that many of the natives are far better qualified to do certain kinds of work than are the European bosses in whose charge they are, the effect being to decrease the attitude of respect for the white man on the part of the Kaffir, as he becomes conscious of his own superiority. The remedy, as pointed out by those who seem to understand the native best, is voluntarily to abolish the color bar in its entirety before the native himself forces its removal; this he can and will do as soon as he realizes his own economic strength. Those who favor this move argue that while the black man is exceedingly proficient at certain tasks, his capacity is limited and that he will never compete seriously with the white man in positions of larger responsibility. A few incompetents presumably would be supplanted; others would doubtless be stimulated by competition to greater exertion and greater efficiency to retain their places. This would be an obvious advantage all round. The native African, on the other hand, would have an opportunity to exercise his best ability with the knowledge that he would be advanced on a basis of proved merit. There are many angles to the native labor problem; yet it seems to us that the stand taken by the opponents of the color bar is sound; that the status of the native should be regulated by capability, rather than by an arbitrary and artificial standard, if it can be done without the risk of inciting the disturbance of peaceful relations between the black and white races—for upon that the stability of civilization in South Africa depends.

FALLACIES are hard to kill. We note that Mr. Herbert Guedalla, chairman of the National Mining Corporation, a highly influential financial combination in London, stated at the recent statutory meeting that the main object of his corporation is "to establish an industrial basis for mining, especially in the baser metals". That is well enough, although mining is an industry, despite anything Mr. Guedalla can do. What he meant probably was that he and his friends intend to subordinate the stock-exchange game to the production of the metals. So far, so good. Next he said: "We wish to eliminate as far as possible the element of speculation,

and for this purpose we propose not only to attend to the production of the mine, but to see that its products are marketed to the best advantage". This should not be a new departure, for it is the basic purpose of mining to produce mineral and sell it at a profit in the nearest market. Mr. Guedalla talks like an amateur. Again it may be presumed that he is hinting at abstention on his part and on the part of his associates from using the mine chiefly as an excuse for queer dealings on Throgmorton Avenue. That we readily believe, knowing the high character of the directorate; but no man by much thinking or by any number of resolutions on his part can eliminate speculation from a business so adventurous as mining. When it ceases to be speculative, it will die of inanition. Another remark of the chairman of the National Mining Corporation is worthy of note: "There may be lucky flukes in mining, but the main element of successful mining is the possession of ample capital for development and machinery". That is an exaggeration. The first thing in mining is to find ore and the second is to stay with it. No amount of capital can make a mine unless an orebody of adequate size is developed, and while to do that calls for the expenditure of labor and money, it is quite certain that the pre-requisite is the necessary raw material, that is, the large tonnage of ore upon which all subsequent operations are predicated. In short, mines are made by mining engineers, not by financiers.

The Greatest Gold Mine

Two years ago we reviewed the records and resources of the leading gold mines of the world and decided that the New Modderfontein, in the Witwatersrand district of South Africa, was the premier. According to statistics recently published, this property had 1860 acres, or 1265 claims, of which 270 have been exhausted; the ore-reserve is distributed over 281½ claims; the undeveloped area comprises 613 claims; 96 claims are recognized as unprofitable; and 4½ claims are allowed for dikes and faulted ground. During last year 29 claims were worked out. The yield of ore averaged 31,750 tons per claim. There remain 520 ore-bearing claims that are intact, and these should yield 14,750,000 tons, in addition to the 8,850,000 tons actually in reserve, that is, blocked out and sampled. The average gold content is 8.6 dwt. per ton. On the basis of an output of 100,000 tons per month, there is 7½ years supply assured and 12 years more probable. During the year ended June 30, 1919, the mills treated 920,500 tons, the average yield from which was 43s. 10d., as against a working cost of 20s. 2d. We would convert this British currency into dollars, if it were of any use, but the fluctuation in exchange renders it futile. A dollar is equal to about 5½ shillings at the present time. The working profit was £1,089,891 and the dividends £875,000, on a capital of £1,400,000. Direct taxation by the governments of South Africa and Great Britain absorbed £215,000. The premium of 17% on gold up to the end of January yielded an additional profit of £121,000 for the current year; this sum ap-

parently will be more than doubled before the end of the fiscal year, on June 30. The chairman of the company, Sir Evelyn Wallers, stated that to yield a clear 7% interest and provide instalments to reinstate capital, carrying interest at 5%, a dividend that continues for 20 years is worth almost exactly ten years purchase. Thus on the actual annual dividend of £3 per £4 share, the shares of the Modderfontein are worth £30, whereas they have been selling at £36. We may add the information that the New Modderfontein Gold Mining Company was organized in 1888 and started milling with 10 stamps in 1892. The present milling plant includes 236 stamps and 15 tube-mills, having a nominal capacity of 100,000 tons per month. The development and equipment of the mine involved an outlay of about £1,200,000. The ore, a gold-bearing banket, is 8 feet wide and dips flatly, so that the workings are only about 2000 feet deep. Dividends to date amount to £5,198,750. In the next 12 years the mine ought to yield at least twice as much more. Thus in a life of 40 years the mine ought to yield 75,000,000 dollars to its owners. Measured by its past performance and its assured prospects, it is, we believe, the greatest gold mine in the world today.

The Great Disillusion

In those days, which now seem so distant, before the Great War, some of us read Mr. Norman Angell's 'Great Illusion' and derived comfort from his insistence that warfare, even successful warfare, had become unprofitable because it was an economic impossibility for one nation to enrich itself by subjugating another, and that the wealth of the civilized world was founded upon credit and commercial contact to such a degree that the destruction of an enemy's credit and the breaking of economic contact with him would be almost as baleful to the victor as to the vanquished. Mr. Angell has not escaped ridicule, for the War seemed to knock his theory to pieces; yet today the plight of the world affords ample justification for much that he said. Our readers have read 'The Economic Consequences of the Peace' or they have read excerpts from it in the daily press. This book has had a profound influence upon the thought of the day, an influence, we think, in excess of its merit as a sustained argument. The author, Mr. J. M. Keynes, was official representative of the British Treasury at the Peace Conference and sat as a deputy on the Supreme Economic Council. He is a professional economist and had unusual opportunities to see the negotiations from the inside. When he saw they were going wrong, from his point of view, he resigned, and forthwith published a highly rhetorical attack upon the whole affair. The picture he gives us is of three men, Clemenceau, Lloyd George, and Wilson, of whom Clemenceau was the only one with a clear policy. That policy was to crush Germany so thoroughly that France would never again be in danger of invasion. The British premier is represented as having an eye on domestic politics and scheming for the purpose of strengthening his personal position at home, while President Wilson is described as a simple-

minded obstinate idealist who was more easily bamboozled than debamboozled. The Fourteen Points, accepted as the basis of the Armistice, constituted part of a solemn contract, which became "lost in the morass of Paris". The humane aspirations of President Wilson and of others in the Allied countries were subordinated to the implacable purpose of the French premier, who, "dry in soul and empty of hope", cared only to pull the talons from his enemy's claws. The fact that he alone spoke French and English interchangeably gave him a technical advantage that must have counted greatly. The British premier knew a little French; Mr. Wilson, none worth mentioning; while the other member of the Big Four, Signor Orlando, knew French only. So Clemenceau acted as interpreter between his colleagues, with consequences that can be surmised. The result was a Carthaginian peace and the sequel will be, presumably, a Pyrrhic victory. These classic allusions may be translated into the vernacular by saying that Mr. Keynes is of the opinion that the gentlemen in Paris, particularly three of them, and more especially one of them, deceived the Germans into the belief that the treaty would be based on the humanities of the Fourteen Points, and then, having got them to lay down arms, proceeded to cinch them in accord with the old-fashioned maxim of "*Vae Victis*" or "To the victor belong the spoils". The financial clauses of the treaty are considered by Mr. Keynes to be so punitive as to defeat their purpose. In this part of the book he gives much interesting information and shows an intimate knowledge of his subject, which would be more convincing if he did not allow himself to be impelled by passion into gross exaggerations. He estimates that, on the basis of the pre-Armistice engagements of the Allies, the claims against Germany should be about 10 billion dollars, a sum that it might be possible for her to pay. Instead, the Treaty exacts something like 40 billion dollars, according to his calculations. This, he says, is not only preposterous but immoral; it means "reducing Germany to servitude for a generation and degrading the lives of millions of human beings" to such an extent, among other consequences, as "to sow the decay of the whole civilized life of Europe". All this, however, must be taken as the personal opinion of a fallible individual, for, expert economist as he is, Mr. Keynes makes a blunder that warrants us in taking all he says with a large grain of salt. "The Review", of New York, points at the fact that Mr. Keynes made a mistake in representing that \$2,500,000,000 in ships, etc., plus thirty annual payments of \$250,000,000, constitute a total of \$10,000,000,000, whereas thirty annual payments of \$250,000,000 have a present value of only \$3,850,000,000, interest being reckoned at 5%, not \$7,500,000,000 as figured by Mr. Keynes. With this serious mistake we may bracket such rhetorical flights as the statement, made apropos of inter-allied debts, that victorious France must pay her friends and Allies more than four times the indemnity that she paid in 1870. "The hand of Bismarck", says Mr. Keynes, "was light compared with that of an Ally or an Associate." Such remarks as these give a fair idea of the temper in which the book was written. It is

not judicial, even though it be granted that something of the kind was needed to awaken the world to the miserable mess created by the ill-informed individuals who undertook to settle the affairs of Europe at Paris. They were ill-informed because no three or four men living knew enough about the intricacies and complexities of economic and political geography in Europe to be able to settle satisfactorily the horrible tangle brought about by the War and its sequel of national and racial self-assertiveness. The leaders, in secret conference, did not make proper use even of the specialists whom they brought to Paris. It is no wonder that many blunders were made; and others like them would be made again if another international conference were to be called, as the 'New Republic' suggests, to correct those of the existing Treaty. The only thing left to do, in our opinion and in that of others better informed, is to use the League of Nations as an agency for modifying the incidence of the terms of the Treaty on the enemy countries, in such a way as to facilitate their rehabilitation and economic reconstruction. What is most needed is constructive purpose, with out which no agreements or contracts will suffice to rebuild a shattered civilization. Mr. Keynes would have us assist Germany and Austria with an international loan of, at least, a billion dollars, but he undermines credit by saying in the same breath that if the inter-Allied loans are not cancelled, the demand for repudiation will arise. If that be so, what reason is there for believing that the enemy-countries will take a different view of a "crushing burden"? Moreover, the latest revolution in Germany, dissipating recent hopes of stable government in that country, is not likely to strengthen the confidence of investors. Mr. Keynes thinks that German exploitation of Russia should be encouraged as a means of bringing a supply of foodstuffs into the service of the world. His plainly is a Germanocentric theory of European economic life; in his anxiety to be humane and to restore the flow of trade, he seems to forget that millions of brave men died not long ago to check the aggression he is now prepared to foster. The German people are unrepentant; they even believe that their armies were not defeated in battle, but overcome by the revolution and the blockade. Sloppy sentimentality is no better than unreasoning vindictiveness. Neither is constructive. What most of us desire is to have an assurance that civilization will not soon again be endangered by the piratic onslaught of any nation and that within sane safeguards to prevent such a contingency there will be devised a plan for giving the enemy countries—for we are still at war—a chance to resume an orderly way of living and hope of regaining the goodwill of those whom they attacked so madly in the fateful years now past. We had hoped for peace and the resumption of industrial amenities long ago. Soon it will be two years since the Armistice. The disillusion has been complete; it looks at times as if the anti-social forces of the jungle were re-asserting themselves and the long and labored efforts of man to improve his status were to be frustrated by misinformation, prejudice, and petty politics.

The Ore Deposits of Mexico—II

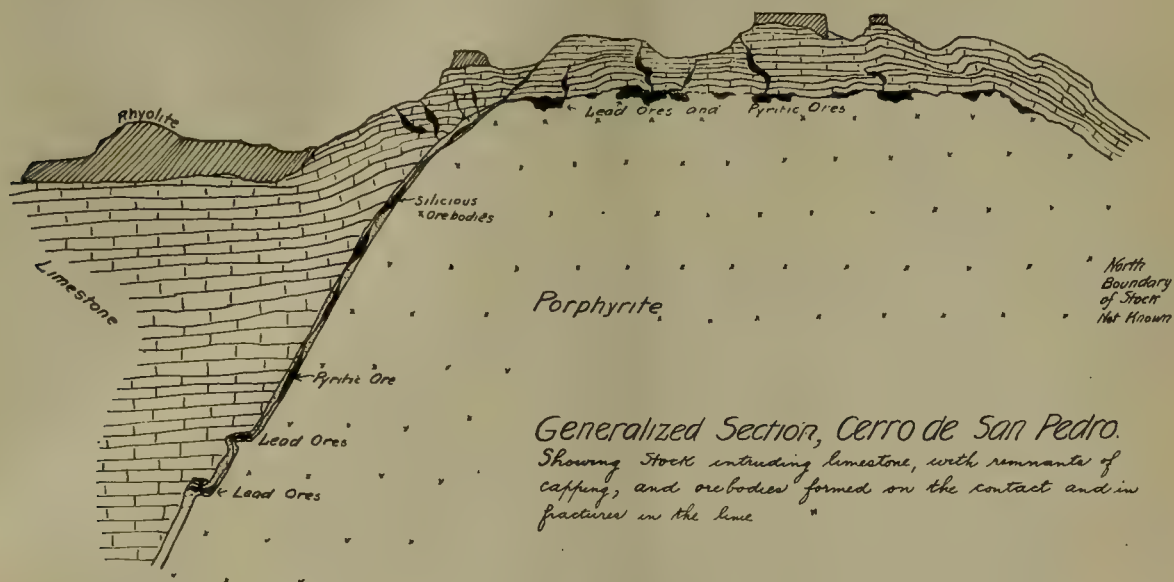
Ore Deposits in Sedimentary Rocks. The Barreno and Ajuchitlan Mines

By S. J. LEWIS

INTRODUCTION. The violent disturbances to which the Cretaceous strata were subjected, especially during the middle Tertiary period, caused extensive fracturing, nearly always in connection with some known intrusion of volcanic rock. Lime is easily dissolved by surface waters flowing for long periods in fractures; therefore at such points we have abundant alkaline waters coming in contact with magmatic waters and gases emanating from the intrusion and carrying traces of the metals. Zones of fracture thus formed in sedimentary rocks, more espe-

generalize the limestone orebodies of Mexico into four groups, as follows:

Class 1. True Contact Deposits. The intrusive is well defined, and is usually a basic rock showing evidence of having cooled under cover of heavy sediments or other rocks. The sediments are usually the heavy 'blue' Cretaceous limestone, sometimes lime-shale. The two rock-members are in contact at any angle from the horizontal to the perpendicular, and the orebodies occur in lenses at or near the contact.



*Generalized Section, Cerro de San Pedro.
Showing Stock intruding limestone, with remnants of capping, and orebodies formed on the contact and in fractures in the lime*

FIG. 3

cially limestone, are particularly favorable to the deposition of ore. As the intrusion responsible for fracturing or loosening of the ground is generally recognizable, and as the points of contact with the limestone, or areas near the contact, are frequently highly mineralized, the term 'contact deposit' is in general use. In some respects such deposits are the most important in Mexico, constituting most of the oxidized lead, copper, and iron ores, as well as most of the zinc. The deposits of the Naica and Santa Eulalia districts (in Chihuahua), Cananea (in Sonora), Ojuelos (in Durango), Tiro General, Dolores, Paz, and San Pedro (in San Luis Potosi), Mazapil and Concepcion del Oro (in Zacatecas) are contact deposits, and have all yielded so much ore as to be of industrial importance.

While each deposit has its own special features, we can

Class 2. Non-contact Deposits. The two principal rock-members are the same, but the igneous rock underlies the sediments more or less horizontally, and the orebodies occur in veins or fracture-zones cutting through both formations, usually at a high angle. In this class the mines are almost wholly in the overlying sediments. Such are the gold-silver deposits of El Oro, Guanajuato, Sultepec, and Taxco.

Class 3. Combination Forms. These show true contact orebodies with the limestone and igneous rock-members, but the mineralization continues into the eruptive rock. The silver mines of the Catorce district are good illustrations.

Class 4. Limestone ore deposits in which direct connection with an igneous intrusion cannot be completed, but

which can be shown to owe their origin to deep-seated sources of mineralization. Such are the lead-iron-zinc deposits of the Monterrey district, the Mitra mountain and San Pedro (Diente) mines.

Most of the important mines of Mexico have been described in the technical press; my purpose is not to make a compilation of the published data relating to such deposits, but rather to illustrate principles of fracturing and circulation by examples drawn from my own observation.

BARRENO. This mine, in the centre of the Cerro de San Pedro in San Luis Potosi, is an excellent example of the true contact deposit. It has produced lead-silver-gold ores since Spanish times, and the surface pockets must have been rich, to judge from narrow stringers of gold ore still occasionally cut in the course of operations.¹¹ The San Pedro district lies about 22 km. east of the city of San Luis Potosi. The principal mines, the Victoria and associated properties, are operated by the Towne interests, the Barreno being the only independent producer of importance. The ores are lead-iron oxides and carbonates with a core of galena, and iron sulphides carrying a little lead and zinc, both classes containing sufficient silver and gold to make them desirable at the smelter. A feature of the Barreno deposit is the large tonnage of lime ore containing precious metals. This excess of lime occurs on and near the surface; with increase in depth there is a gradual but steady rise in the silica content and a corresponding drop in the lime.

The characteristic topography of the desert region is carved out of Cretaceous limestone, the 'blue' limestone of northern Mexico. The strata show great thickness, rising slowly from the flat plain of the present valley to the foot-hills. This plain was covered during early Tertiary time by several silicious volcanic flows, of which the remains of three can still be recognized. The first and earliest is a typical rhyolite, with flow-lines and inclusions of ash; it is found with great difficulty on the slopes of the Dos Luceros hill, across from Barreno. The second is a black glassy rock with perlitic fractures; of this some is left on the Barreno hill itself as well as on the slopes going down to the valley. The last, a rock of trachytic texture, with large quartz crystals and well-marked inclusions of ash, still survives in large bodies, except where deep-seated ground movements have broken it up and facilitated removal. The almost complete erosion of the first two caps gives one an idea of the wide intervals of time that must have elapsed between the successive depositions. See Fig. 3. The last cap, the only one generally known, is locally identified as the rhyolite and survives merely as small buttes on the tops of the higher points in the district. It is from 25 to 100 m. thick, its surface being level from one peak to another.

The ore deposits are associated with an intrusive rock of quite different character, which invaded the limestone and exerted a profound influence on the topography. It is my opinion that the rhyolites existed prior to this intrusion, which was probably of Miocene age, and that

their only influence on the deposits was to afford protection from erosion and oxidation. The Barreno laccolith is a diorite-porphyrite intrusive, which pushed its way into the strata on a great scale, so that it now underlies the whole district. A local protuberance from the laccolith forms the Barreno hill, although it is nowhere visible at the surface. The topography of the buried mass has been well worked out in the course of centuries of mining operations; it is in the shape of a prismoid, or tooth, about 400 m. wide on its south face, and dipping to the south at an angle of about 55°; it is probably much longer on its east and west faces, the latter being unexplored and the former being known only in the Cocinera mine. This old mine, on the so-called east contact, shows mineralization like that of the Barreno, at a depth of 300 m. below its surface, and 500 m. below the crest of the Barreno deposit.

The north face of this intrusion stretches to an unknown distance, making a rough undulating top to the structure, going north in a band about 400 m. wide and at least 1000 m. long. The ore is found in roughnesses or pockets formed by the undulations of this underground surface, in contact with the overlying sediments; on the east and south contacts of the sloping walls of the intrusion, occurring both in the porphyrite and in the contiguous limestone; and finally, in great bodies formed at a little distance from the intrusive, entirely in the lime. This ore was deposited in immense fractures in the sediments that were opened as the intrusive pushed its way; and it has been possible to follow the fractures down for hundreds of metres, to the junction with the south contact of the intrusive. That the ores deposited in the cave-like fractures owe their origin to mineralizers coming out of the hot igneous rock-mass, there can be no doubt. The accompanying sketch (Fig. 5) shows a diagrammatic section through the ground, making clear the above-described relations. The photograph (Fig. 4) shows the Barreno hill, with some of the important fractures in the limestone, which have been worked down as far as the igneous contact probably, but which are filled with debris for some distance above it.

Three stages are distinguishable: first, deposition of large bodies of primary iron sulphides, carrying low precious-metal contents; second, a later stage of the same period, the entrance of silicious solutions carrying lead, mercury, antimony, arsenic, zinc, and other base metals, with an increase in gold and silver. There seems to have been considerable shattering of the limestone preliminary to this stage and accompanying it. Finally came the effect of atmospheric and circulation agencies, making a period of oxidizing enrichment of the iron-sulphide ore-bodies.

In the first stage, soon after the solidification of the intrusive, the hot waters and gases coming out of the latter attacked the limestone along the contact, and also passed up into the fractures in the sediments. Along the contact, crystals of iron pyrite were deposited both in the porphyrite and the limestone, apparently replacing rock-minerals in both, besides entering minute fractures in the latter. In the porphyrite, the crystals of pyrite are gen-

¹¹By permission of R. Amilien Lacaud, President, Cia. Minera El Barreno y Anexas, Mexico, D. F.

crally scattered, in places so much as to make the rock valueless; in the limestone, all stages of replacement are found, beginning with a dark, highly-silicified rock with scattered pyrite in narrow bands, and going through every imaginable stage to a solid glistening mass that preserves perfectly the original bedding-planes. It requires

stitution of lead molecules for iron molecules has been perfect. Under the microscope, two stages of change are distinguished: minute fractures, carrying mercury and other base metals, with the later products of oxidation; and chalcedonic quartz, the latter lining tiny veinlets and openings.



FIG. 4. BARRENO MINE. CIRCLES SHOW OLD WORKINGS FOLLOWING FRACTURES IN THE LIMESTONE

only a glance at these beds, having all the appearance of limestone strata until a stroke of the hammer reveals the shining sulphide, to carry conviction as to the origin of these orebodies. The magmatic emanations from the intrusive, rich in iron, found favorable conditions for chemical reaction and deposition of mineral in the basins formed by local unevenness of the contact; so that in these depressions, or pockets, bodies of pyrite have been precipitated, erratic in size and shape, as well as in their metal contents, but consistently showing that they were formed by replacement of the lime molecules through reaction with acid salts of the metals.

During the second period, further movement and loosening of the ground allowed fresh solutions to enter, bringing in lead and silver; these attacked the pyrite crystals, dissolving some of the iron and depositing lead, zinc, and other metals. This continued for a long period, with consequent enrichment of the deposit. As convincing evidence of the process, we find pseudomorphs of lead after iron, that is, the crystals are of the shape and appearance of pyrite, but on breaking them they are found to be wholly of lead. The sub-

characteristic striation or grooving of the pyrite crystals that once filled them, leaving no doubt of their removal. By this action, considerable masses of ore have been made profitable, for their gold contents, that would otherwise have been too low-grade for working. The iron sulphate formed during the leaching process had a favorable in-

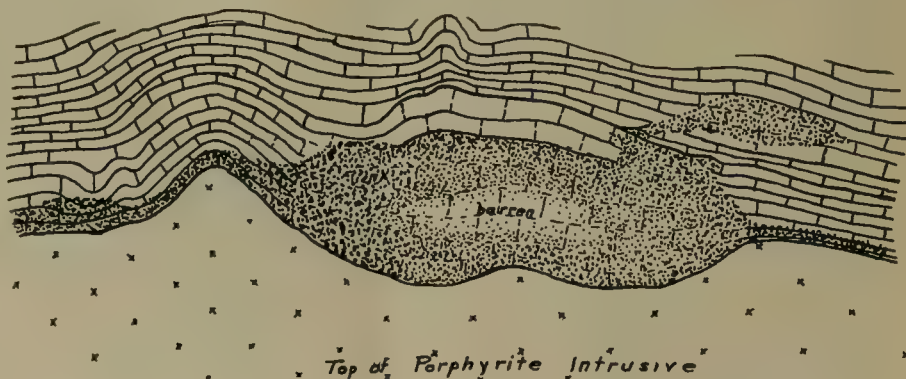


FIG. 5. ILLUSTRATING STRUCTURAL GEOLOGY OF THE BARRENO MINE

fluence in precipitating such gold as may have been carried in solution. Traces of oxidation are visible deep down in the deposits, along the contact-faces of the intrusion. Sinking on the south face in Barreno has reached a depth of about 300 m., and the oxidation appears to be almost as thorough as in the upper workings.

But while such secondary processes were important, a

highly significant rôle attaches to the second stage of mineralization, in which deposition from a thinner and somewhat silicious solution, coming direct from the intrusive, and evidently an end-product of the magma, did much to enrich the orebodies. That the original pyritic masses were subjected to attack by such later solutions is shown by the fact that nearly all of them, especially the larger bodies, present a perfectly uniform appearance to the eye, in section through the mass, but have a practically barren core of iron sulphide carrying no silver or gold. On breaking into a mass, the good ore will be near the outside, diminishing gradually toward the centre, where it is quite usual to find barren pyrite, presenting identically the same appearance as the ore. In most cases, stopping stops in such ground, for obvious reasons; however, exploration has been carried through the barren core in a few cases, with an improvement in gold-silver contents as the opposite surface of the mass is approached. Oxidation has left but few traces in these bodies, so that the difference in value is due, not to secondary enrichment, but to deposition from later magmatic emanations.

The foregoing is descriptive of the iron-lead orebodies found in pockets on the rolling upper surface of the intrusive; hence of the greater number in the district and the most exploited. The next most important group is that of the great caves, like Porvenir, Cinco de Mayo, and Santa Clara, in which for centuries stoping of lime-rock containing gold and silver has been profitable. Outcropping at the surface, and going down as immense fractures through the strata to the intrusive, oxidation has played the chief part in the transformation of the primary iron sulphide. The rock is to all appearance thoroughly oxidized and quite free from pyrite. It carries abundant sulphides, however, as shown by concentration either on tables or on the batea, with lead, zinc, and manganese as carbonates and oxides. That the enrichment originally came from mineralizers connected with the eruptive, is indicated by the frequent occurrence of rich streaks of gold-silver ore, two or three inches wide, running down vertically without evidence of fracturing, the value gradually diminishing on both sides till barren limestone is reached. (See Fig 6.) The total width of impregnation is usually from one to two metres in the case of a rich streak, the whole appearing like a zone of impregnation. The same is true where the fracture is visible; in both cases, the enrichment has begun along a line of weakness or a channel of circulation, and worked its way into the limestone as far as it could, as in some of the instances noted by Irving.¹²

The rich streaks in these caves have been stoped very deep, and the old holes have been in bad condition during modern times; it is therefore impossible to follow them quite to their point of connection with the intrusive; however, they have been explored to within a few metres of it, so that the indications are that the connection existed during periods of mineralization. Evidently every crack

in the limestone became a centre from which gases and solutions worked their way into the strata until their strength was spent, making the orebodies described, and forming blanket deposits of lead-iron ore by selective action on certain strata. (See Fig. 7.) There is no difference to the eye, in these limestone orebodies, between profitable ore and rock too low-grade to be classed as such; the difference is simply that the former is broken out from channels of mineralization, and the latter is at a distance from them.

Finally, we have the contact bodies on the inclined faces of the intrusion. On the south incline, which for many years was spoken of as the 'break', the heavy ground-movements, with the strong oxidation due to free circulation, has caused the whole structure to assume the appearance of a fault-fracture or vein-fissure, with thick gouge and occasional lenses of ore. The hanging wall is limestone, the foot-wall porphyrite. Silver and gold are found in both walls and in the crushed material between. Wherever the generally smooth face of this inclined contact has a local wrinkle in it, forming a little shelf, small bodies of rich lead-silver ores are found, always well oxidized, and containing gold and silver. In general, it may be said of this contact that the most generous deposition of silver and gold was accompanied by the highest proportion of silica, when we speak of ores in the porphyrite. In the limestone ores, the richest precious-metal ore was found at the surface, accompanied by high lime-content and little silica.

Without going into further detail in the study of this interesting deposit, we see from the foregoing that deposition directly from magmatic solutions played a chief part at the beginning; that subsequent deposition from solutions of similar origin, now grown extremely silicious and carrying gold and silver as well as the other common metals, was of great importance in enriching them; and that finally the circulation of surface-waters has had an enriching and oxidizing effect wherever they could get into the orebodies: a highly complicated interchange of elements, which to some extent mineralized the whole Barreno hill, and made ore in and near the circulation channels.

The great fact to which all study of this district points as the basis of mineralization is the fracturing due to the intrusion, from which resulted a complex system of channels in which waters could circulate, and a supply of magmatic waters to carry the minerals.

AJUCHITLAN. Another good example of the true contact deposit in Mexico is afforded by the Ajuchitlan mine in the State of Queretaro; with the interesting difference that the orebodies occur in lime-shale, like that of El Oro, instead of the blue limestone of the Cerro de San Pedro. Like these latter deposits, the Ajuchitlan mines have three rock-members: the country shale, in which the deposits are found; an intrusion of igneous rock, responsible for the deposits; and a cap of andesite, also antedating the intrusion and protecting the ore.

The Ajuchitlan mines¹³ are about 20 km. east of the city of Queretaro and have been worked from the earliest

¹²J. D. Irving, 'Replacement Orebodies', in 'Economic Geology', Vol. VI, 1911.

days, the old Santo Tomas mine high on the outcrop, just under the cap, belonging to Spanish times. The formation is black and gray shale, clearly early Cretaceous. The shale rests unconformably on a heavy blue

tainly Comanchean in period, I should say. It is not visible anywhere else in the area, and the ore deposits are wholly in the shale, which is at least 1500 ft. thick, probably more. An extensive flow of andesite, similar to the

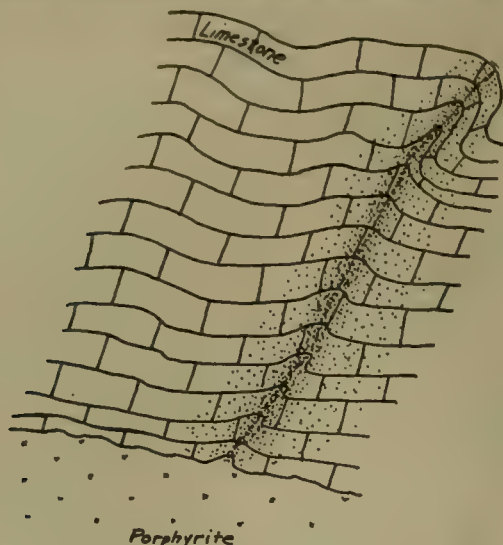


FIG. 6. IMPREGNATION OREBODY

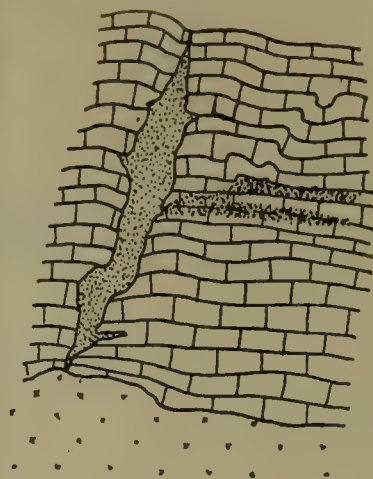
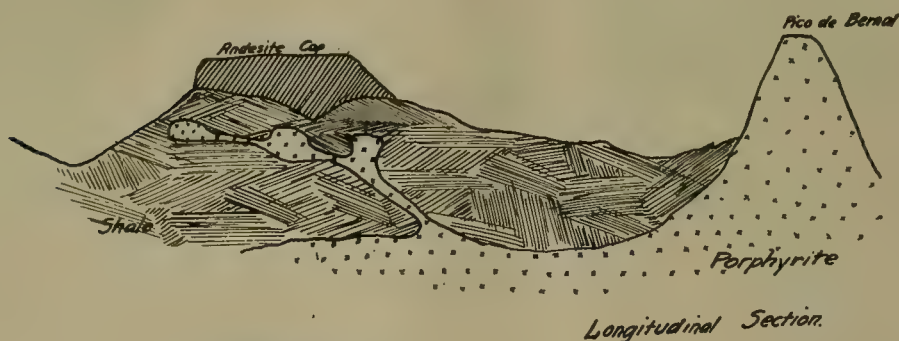
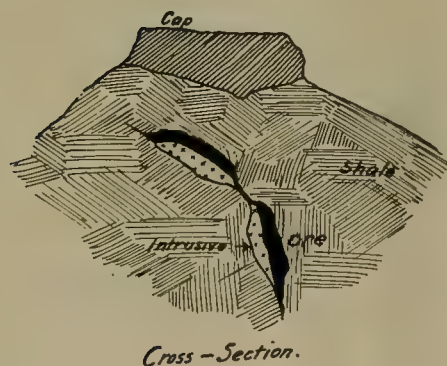


FIG. 7. CAVE AND BLANKET OREBODIES



Longitudinal Section.



Cross-Section.

Diagram Sections of
Ajuchitlan Formation.

FIG. 8

limestone, and fossil oysters of Lower Cretaceous type are found in the debris below. A good exposure of the stratigraphy occurs in an arroyo on the Bernal side of the Ajuchitlan mountain. The blue limestone is cer-

¹³With acknowledgments to C. Crowell, President, the Ajuchitlan Mining & Milling Co., Monterrey, N. L.

El Oro cap, covers the higher parts of the cliffs and forms a level rim-rock around the north-eastern horizon. (See Fig. 8.) All the features of the old topography are visible near the mines: the Cretaceous valleys and peaks covered with the andesite, the highly enriched ore deposits outcropping just under it, and the white intrusive,

of Miocene age, that originated the mineral. One of the difficult features of exploration underground has been the necessity of driving through a Cretaceous arroyo filled by waste from the erosion of that period, and later covered by the andesite.

The igneous intrusion, whose association with the ore deposits is so close as to leave no doubt as to origin of the latter (Fig. 8), is a white close-grained porphyrite, with sparse quartz crystals speckling it, and is locally known as 'rhyolite'. It is of special interest on account of the way it has penetrated the shale, shooting out tongue-like masses on one side, which have become cores of mineralization. The centre of vulcanism for this whole area, from which this 'rhyolite' has come, is probably the tooth-like butte visible from the railway, known as the Pico de Bernal, which pushed its way through the formation, lifting shale and cap and facilitating the removal of the latter from all the section except the tops of the hills. The soft shale wore away rapidly, so that the Pico is bare to its base. The disturbance of the shale, both in bedding and composition, near the Pico, twisted it in every direction and caused great chemical alteration. The normal black color of the sediments is changed to red, buff, and purple where the sharp tooth protrudes through them, making a striking feature of the landscape. The mine lies about 5 km. west, on the opposite side of the Ajuchitlan mountain. The material of the Pico is in every way the same as that of the mine intrusive, and the inference seems to be warranted that they are both local excrescences from an immense underground mass. The introduction of this mass into the shale fractured it violently; in the case of the Pico, the mass came to the surface and everything around it has been eroded; in the case of the mine intrusive, it pushed its way up to the cap and spread out or mushroomed under it; the cap protected the deposits from erosion, so that the chemical effects of the intrusion on the shale were saved for later exploitation.

Reference to Fig. 8 will show that much influence was exercised by small tongues of porphyrite pushed out from the mass and brecciating the shale near-by. This broken zone was saturated with vapors and waters emanating from the intrusive, and a little mineralization took place; but the principal effect seems to have been produced about 25 m. away from the intrusive, in the mineralization of certain shale strata, always on one side of the rock protrusions. The intrusive mass itself is about 300 m. wide, so far as known, but it may be much more. While the fact of the orebodies occurring more or less uniformly at this distance from the intrusive may be due to selective action, it seems more likely that difference of temperature at a distance from the hot intrusive was the deciding factor. The period of primary mineralization seems to have been brief and uncomplicated, and to have left irregular masses of quartz-breccia, from one to eight metres thick, in lenticular bodies a few metres removed from the tongues of porphyrite, and each lens practically independent of the next. Small rich pockets of iodides, bromides, and chlorides have been found, usually in the upper workings near the cap. The ore, in which the

value is equally divided between gold and silver, is an extremely hard silicious replacement of the finely-crushed shale ground up during the fracturing. These fragments, cemented together by the silicious solutions that brought in the gold and silver, form a characteristic breccia, sharp-pointed and triangular, with little indication of up and down movement of the walls.

The end of the period of primary mineralization was accompanied by settling and cross-faulting of the recently formed quartz bodies. This led to typical fault-enrichment of the kind that forms such a marked feature of the El Oro deposits, that is, the neighborhood of a fault-fracture invariably shows enrichment of the quartz. Evidently the new cross-channels served for the movement of fresh later solutions carrying additional mineral, as well as for the entrance of surface-waters to do the work of secondary enrichment. Oxidation has been so thorough that no sulphides occur in the deposits at all; they are merely silicified shale fragments with a little silver and gold in them.

It will be evident from the foregoing that the whole mineralization is due to the intrusion and to the after-effects of re-enrichment. In planning exploration, therefore, the central feature has been the intrusive, and the miner has sought to follow it, finding lens after lens, usually at 25 to 30 m. from the intrusive. The similarity in general features between these deposits and those of the Cerro de San Pedro is striking. On structural grounds, the two deposits go at once into the same class. The difference is mainly that of the country-rock in which the mineralization took place; in the case of the limestone we get a lead-zinc-iron deposit low in the precious metals; in the case of the shale we get gold-silver ores with practically no impurity. This condition is probably owing more to the difference in chemical reaction of the rock than to any other one factor. The outstanding feature is again the fracturing of the shale and the entrance of solutions from the intrusive into the channels.

These two examples show every feature of a contact deposit, including the protecting cap. It is more usual to find contact deposits with some of the features lacking, but a complete history of them can be built up by a study of several mines in the same district. Of this nature are the interesting iron deposits of Michoacan and Colima, near the West Coast. The showings near Coalcoman are characteristic of this class. The limestone sediments, which are extensive, have been disturbed by late intrusives, generally the monzonite-granite that is found in many copper districts of this region; it grades occasionally and locally into a fine-grained diorite. The upper surfaces of the monzonite masses, in contact with the lime, are frequently enriched by copper and iron; the former occurring as a flat blanket lying directly on the granite, usually but a metre or less in thickness, and showing extensive alteration to carbonates and oxides. Lying on top of the copper is the iron, a cap 50 to 100 ft. thick, and showing pure oxides with 60% iron. Careful study of the rocks shows that the mineralization is the result of replacement of the limestone by iron, followed by secondary action. In many cases, the unaltered lime-

stone lies on top of the iron cap, so that the series is complete as regards the flat contact type.

Other deposits nearby show the immense fractures across the limestone strata that form such a marked feature of the Cerro de San Pedro; these contain copper, zinc, and iron, practically unoxidized a few metres from the surface, and with fine secondary silicate minerals,

show the vertical fractures in the limestone without the gossan; both disclose the granite intrusive. It is evident that originally all members of the series existed, the granite intruding the limestone and forming the fractures, and the mineral solutions proceeding out of the granite to circulate in the limestone so as to make ore. See Fig. 9.

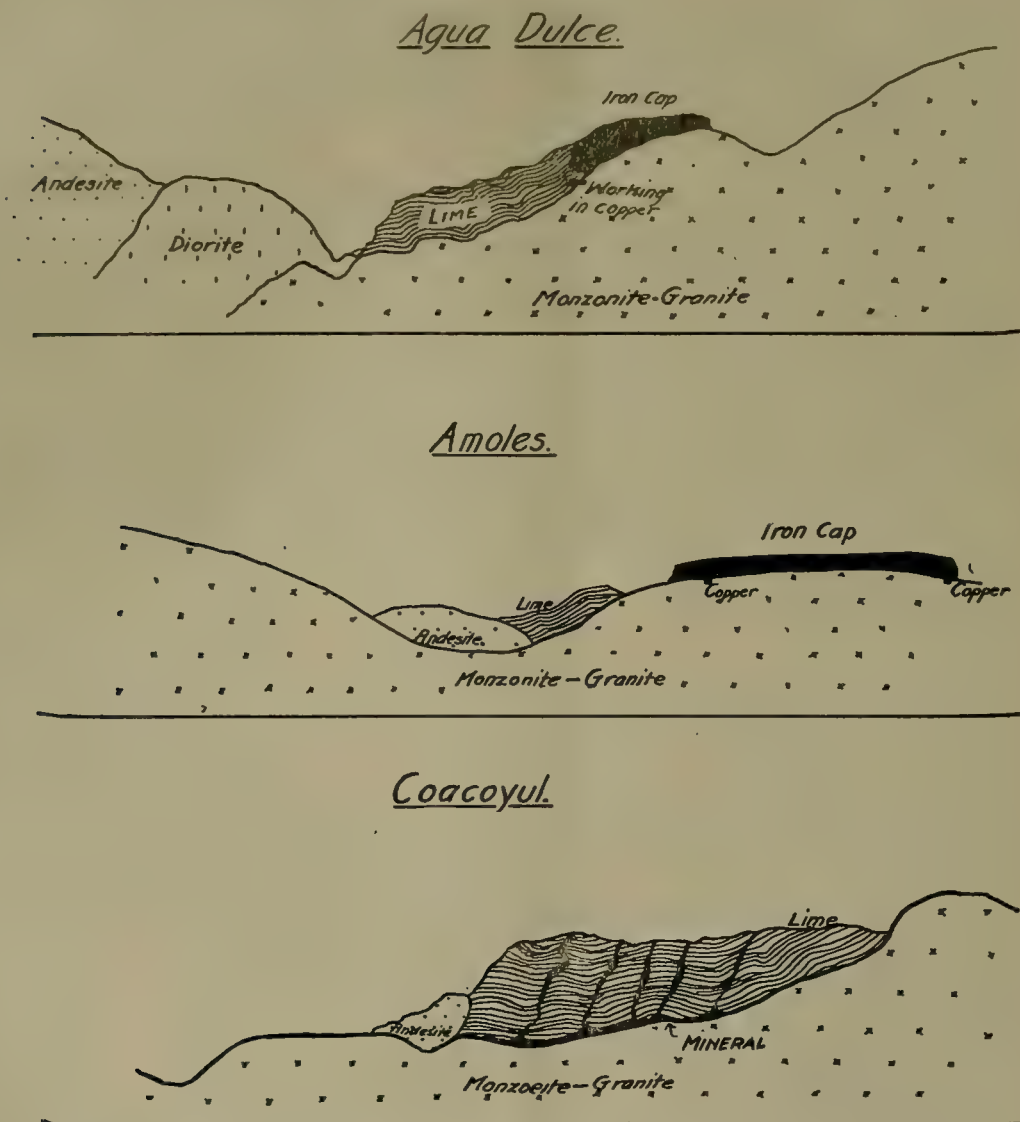


FIG. 9. SECTION ON CONTACT OREBODIES IN SOUTH-EASTERN JALISCO

such as are usually found at contacts. The limestone is underlain at considerable depth by the granite, the contact being buried; so that by grouping deposits that lie near each other and all in the same general horizon, we get a composite structure exhibiting nearly all the features of the Cerro de San Pedro. The Amoles mines show an extensive boss of monzonite, crowned with thick and pure iron gossan, with a copper blanket below the iron and unaltered lime above it; other points near-by

Nearer to San Luis Potosi, at Charcas, there are contact deposits that in all essential features are identical with those of the Cerro de San Pedro. The country-rock is the same blue limestone as at San Luis, which has been intruded by dike-like tongues of porphyrite. Microscopic examination of this igneous rock shows its likeness to the Barreno intrusive, the large phenocrysts of quartz and feldspar being especially clear; the difference lies in the lack of mica in the Charcas rock. The orebodies are

found on the nearly vertical contacts of these dike-like masses with the limestone, occurring sometimes in one, sometimes in the other; seldom in both at the same point. In the Tiro General mine, the largest in the district, mineralization seems to have formed immense bodies of pyritic ores with most of the base metals, very much as the same minerals were deposited at Barreno. The present highly oxidized condition is the result of later oxidation. Both in the Tiro and in smaller mines of the district, fracturing of the limestone by the intrusion of the porphyrite has evidently made the ores, as circulation has taken place on the contacts themselves. The inference is that immense blocks of limestone were floated on the intrusive mass until the latter cooled.

The series of caps that were important at San Pedro in protecting the deposits from surficial agencies are here conspicuous by their absence. It would seem that these intrusions came into the district coincidentally with that of San Pedro, fracturing the strata and shearing them, and solidifying in sheet-like masses which stand vertically. Owing to absence of cap, surface destruction was thorough, and the upper portions of the series were completely removed, making about 2000 ft. of rock that has been eroded. Thus we find no irregular cave-like orebodies in the limestone, except a few high up in the topography; nor are there horizontal contact bodies on the upper surface of the intrusive; but nearly vertical vein-like bodies accompanying the dikes. What is left at Charcas is the lower portion or roots of the deposits, corresponding to the deeply buried part, perhaps, of the San Pedro formation.

An interesting feature of this Charcas camp is the effect of the heavy fracturing on both sediments and igneous rocks at a little distance from the centre of movement. Narrow but persistent fractures have been made, in which circulation has deposited ores of a type totally different from those of the contact bodies; but the origin of these different ores, viewing the district as a whole, is clearly in the same intrusions that made the great contact bodies.

A fine example of the true contact orebody, in which the metals above mentioned do not appear at all, is found in the Santa Maria antimony mines on the Zoyatal mountain in Queretaro, 90 km. north of Bernal station on the National railway. The ores are exclusively antimony of great purity, without lead, iron, zinc, arsenic, silver, or gold. For this reason they are of special interest as regards the origin of the mineral.¹⁴

There are three rock-members in the formation, as shown in Fig. 9. The original surface was of lime-shale in thin laminae, the whole probably 1000 ft. thick. These rest unconformably on the Lower Cretaceous limestone, which is from 300 to 1000 ft. thick. Below this and intruding into it, is a laccolith of dark, heavy, finely granular rock of ferro-magnesian type, probably a gabbro, which has pushed its way up through the other two members, destroying the shale locally and carrying the lime-

stone high above them to form the hill. The small tongues of eruptive proceeding out of the main mass form narrow, almost vertical, pockets having a limestone-gabbro contact, in which the limestone is replaced by the sulphide of antimony. The mineral is never found in the eruptive, and mineralization ceases as soon as the limestone ends. Quite clearly, deposition took place by replacement of the lime. The antimony occurs as practically pure sulphide in fine crystals, accompanied by calcite and gypsum, also well crystallized. One would suppose that the antimony was deposited from alkaline solutions, and there is room for study to determine why it came down without admixture of other metals.

Oxidation has been extensive but not thorough, nearly all the oxidized ore showing a core of unaltered sulphide. The principal orebodies are found at a distance of from 35 to 50 m. above the contact, except in the small vertical contacts like the Colmena; they occur either as replacements of the limestone, or in built-up aggregates of fine crystals filling openings made by ground movements. Crystallization is just as perfect in the case of the solid dense limestone where there is no evidence of opening, the crystals occurring as beautifully branching growths beginning at a circulation channel and growing into the texture of the limestone for a distance of a metre or more. In such cases, the crystals are generally pure sulphides; many cases are seen, however, where these branching crystals are almost entirely oxidized in place; they are fine examples of replacement from mineral-bearing solutions.

In general, the occurrence of ore is like that in lead mines of the contact type; the orebodies are blanket deposits from 50 cm. to 3 m. thick, replacing one or more nearly horizontal strata, with especially good enrichment at points where vertical cross-fracturing has taken place; in which case the ore continues into the fractures and in favorable cases forms parallel blankets by spreading out into adjoining strata.

That the mineralization of these deposits is due to emanations from the laccolith, rising through narrow and perhaps obliterated channels into the limestone horizon, seems evident. It is interesting to compare the deposits with the Ajuchitlan mines, noting the resemblance in deposition at a short distance from the intrusion, the resemblance also in shape of the protrusions from the igneous mass, and the striking difference in mineralization. That in the one case the intrusive is a nearly white, highly acidic rock, yielding gold-silver mineralization, and in the other is a dark, ferro-magnesian, basic rock, yielding antimony without a trace of gold or silver, is certainly suggestive.

AMERICAN MAGNESITE is purer than the Austrian material, which, by virtue of its content of a small amount of iron in just the proper amount, is better suited by nature for use in the steel industry. However, the early difficulties encountered in the use of domestic material have been quite satisfactorily overcome. The lack of the desired amount of iron in American magnesite is met by adding iron synthetically.

¹⁴By permission of Olive Cookson, Newcastle-on-Tyne, England.

Mine-Sampling

By WILLIAM HUFF WAGNER

INTRODUCTION. The methods of taking samples and the system of keeping stope and assay-maps described in this article are applicable especially to the mines of the Butte district. While the methods were devised by the engi-

In the mining of copper ore in the Butte district, sampling is becoming of more significance every day, and all the operating companies are gradually giving proper recognition to this branch of technical practice. The im-

portance of the subject is being driven home more forcibly as the mines attain greater depth. With depth, all mining problems become increasingly difficult and costly, and consequently the need for economy in production enters more and more into the conduct of operations.

The operating officials appreciate the higher cost of mining the ore cleanly, and the lower cost per ton of a product containing a larger admixture of waste, but they realize that there is a mean point at which the maximum profit to the enterprise is ob-

tainable. The average foreman or shift-boss, however, seldom understands this relation. To many of the latter higher tonnage per man-shift invariably means low costs, and this false conception leads to the breaking of con-

2206 Stope										2206 Stope									
Date	1st Class	2nd Class	3rd Class	4th Class	5th Class	6th Class	7th Class	8th Class	9th Class	Date	1st Class	2nd Class	3rd Class	4th Class	5th Class	6th Class	7th Class	8th Class	9th Class
1										16									
2										17									
3										18									
4										19									
5										20									
6										21									
7										22									

Handwritten entries in left page:
 1 East
 5 East
 2 West
 10 Special
 3 East
 7 East

Handwritten entries in right page:
 3 West
 8 West
 20 pile grab - 20 12

FIG. 1. SHIFT-BOSS'S SAMPLE-BOOK

neers of the North Butte Mining Co. to fit the conditions existing in a particular group of mines, they can be modified readily to apply to deposits worked by other methods than those in vogue at Butte.

The success of any mining operation depends in large part on the accurate knowledge of the composition and metallic contents of the material in the faces exposed in the mine, as well as of the ore broken for shipment or local treatment. This knowledge is of especial importance to a company that sells its ore to a custom smelter; in this case it is frequently necessary to maintain a specified grade or be penalized, and this latter may represent the margin between a profit and a loss.



FIG. 2. TYPICAL STOPE-SECTION

siderable wall-rock along with the vein-material; it causes the failure to apply selective mining (separate blasting) to the narrow veins, and the neglect to sort ore, all of which results in an excessive proportion of worthless rock being hoisted to surface. The grade of ore shipped is bound to suffer, and the final and most important cost, that is, the cost per pound of copper, will rise, although the cost per ton of ore may fall somewhat.

SAMPLERS AND THEIR EQUIPMENT. Correct sampling is one of the most difficult of mine operations, and since its bearing on the grade of ore is vital it behooves a company to select its samplers carefully. These men need not necessarily be technical men, but such generally are preferred. The men chosen for samplers must be alert and wide-awake, they must have a good knowledge of mining and of the rocks and ores to be sampled, and, above all, they must be thoroughly reliable and honest. It is often difficult to get men for this work because it is hard unpleasant manual labor as viewed by most men in the mines. They should be on a salary and be directly under the chief engineer or the geologist, preferably the latter, as is the case in the North Butte organization. Their working outfit consists of a sample-pick one foot long, a supply of twine and cloth sacks, small paper pads, pencils, one 75-ft. metallic tape, and one 2-ft. Lufkin box-wood angle-rule. A sample taken by channeling with a moil and single-hand hammer is acknowledged to be more accurate than a sample cut with a hand-pick and caught in a bag, but the needed paraphernalia is bulky and awkward to carry. Further, I believe that, considering the small amount of material cut, we can by careful work with the sample-pick cut a representative sample.

SAMPLING IN STOPES. Our scheme of sampling is as follows: The ore is sampled by the regular samplers before being mined; samples are taken generally in alternate sets as advance is made along each floor, or, in special cases, at closer intervals if the grade of the ore is low or the vein irregular. The samplers make a custom of taking grab-samples from the broken ore in the stopes and similar samples from the cars on the levels, using these to check the samples from the faces, and to see how cleanly the ore is being broken and sorted. The ore is sampled at the mouth of each chute by one of the motor-crew, a handful being grabbed from each car as it is being loaded. This sample is placed in a box close to the chute. The same man again samples the ore at the station, by taking a handful from each car as it is dumped into the skip-pocket. This goes into the general sample-box at the station. The process is repeated at the train as the railroad cars are loaded from the surface-bins preparatory to haulage to the smelter. This last sample is taken by one of the loaders, all the car-samples being then combined to form one train-sample.

To secure a representative grab-sample from the motor-crews is one of the most difficult tasks we face, because these men do not appreciate the importance of careful sampling and therefore slight the work. They have been known to take the sample representing an entire shift

from one car; they will even salt the sample purposely; or innocently grab the richer fine from the top of the car. The problem is largely one of careful education of these men, and only by constant attention can these difficulties be overcome.

DEVELOPMENT-SAMPLING. In the development of new country by cross-cuts, drifts, and raises, special samples and advance measurements are taken weekly on 'development day' by the regular samplers. In addition, when the vein is irregular, or the grade of the ore is low, or new features appear, the faces are sampled after each round. In drifts, the shovelers sample the cars while loading by throwing a handful from each into a box supplied for that purpose. All the samples from development work are assayed for copper, silver, and gold, and sometimes for zinc, whereas the samples from the stopes are assayed for copper only. Detailed records are kept of all development-assays and from these the value of the ore-reserves is calculated.

METHOD OF TAKING SAMPLES. The usual method of sampling as applied to all development and stope-work is as follows: In the case of narrow veins (less than one set wide), separate samples of the vein and wall-rock are taken. If there are foot-wall and hanging-wall streaks with a horse of waste between, separate samples of all three are taken. For a full face of ore of uniform grade, one sample straight across the face will suffice; but if one part of the vein is richer than another, it is better to sample the two portions separately, at the same time noting and recording the respective widths. In cross-cuts and raises, both the faces of ore exposed are sampled, their average assay being accepted as the correct value of the ore.

In order to reduce the possible error to a minimum, if the face to be sampled is 8 to 10 ft. wide, the distance should be divided into two equal parts and two samples cut. If wider still, more samples should be cut, each one being confined to a width of four feet. The face to be sampled is first brushed and cleaned thoroughly; then the samples are taken by cutting a groove 2 to 4 in. wide and 1½ to 2 in. deep, using the sample-pick along a line at right angles to the strike and dip of the vein, catching the sample either in the hand or directly in the bag, which is held open by a wire-hoop. The finished sample weighs from 3 to 5 lb., its size depending on the width sampled.

The regular samplers deliver all their bags to the station-tender as they leave the mine at 2:45 p.m., while the individual chute and station-samples are delivered to him by the various motor-men at the end of the shift. All samples are taken to the surface immediately, where they are picked up by the motor-man and delivered to the assay-office. There the motor-man finds an order for empty sample-boxes left by one of the samplers, and, securing the requisite number, he takes them to the collar of the shaft, whence they are lowered to the levels as specified on the order.

All the stope samples are identified by means of paper tags giving complete information as to date, chute-num-

ber, floor, number of sets east or west from the chute, width sampled, and position on the face; samples taken by the motor-crews are tagged as to date, chute or station number, and the shift on which they were taken. These

- Less than 2 Ft.
- 2 Ft. to 3½ Ft.
- 4 Ft. to 6 Ft.
- 6½ Ft. to 8½ Ft.
- 9 Ft. +
- Less than 2.0% Cu.
- 2.0% Cu. to 3.0% Cu.
- 3.0% Cu. to 4.0% Cu.
- 4.0% Cu. to 5.0% Cu.
- Over 5.0% Cu.
- 2½ Ft. to 3½ Ft. waste between streaks
- 4 Ft. to 6 Ft. " " "
- 6½ Ft. to 8½ Ft. " " "
- 9 Ft. to 11 Ft. " " "
- Over 11 Ft. " " "

FIG. 3. SYMBOLS

latter samples are marked by the shift-boss as he goes through his 'beat'.

CRUSHING AND ASSAYING. At the assay-office each sample is put into an iron pan, to which the tag is secured, and which is placed immediately in the drying-ovens. The following morning the samples, being dry,

are crushed, mixed, and cut down with a Brunton rifle in the usual manner. They are next ground in a disc pulverizer and forwarded in small iron pans to the laboratory for immediate assay.

The copper content in stope samples is generally obtained by the colorimetric scheme, whereas on all development, check, and special samples titration by the cyanide method is used. The results, entered on regular report-sheets by the assayer, are delivered to the samplers' office by 3 p.m. There the samplers transfer the results to the shift-boss's books, shown in Fig. 1, and plot the stope and development assays on the assay-maps. Fig. 2 shows a typical stope-map and Fig. 3 illustrates the symbols used.

ASSAY AND STOPE-MAPS. The assay-maps, drawn on a scale of 1 in. to 40 ft., seem to meet our demands and give the company an absolutely correct and detailed record of its workings. They are kept up to date daily by the samplers. The latter can, by coming out of the mine at 2:45 p.m., enter the results in the shift-boss's books and make the necessary entries on the maps by 4:30 p.m. when the whistle blows. These maps are kept on swinging wall-panels (Fig. 4) in the engineer's office at the mine and are always accessible to the bosses or mine officials. On the same maps are placed vertical sections, always up to date, of development raises, showing the structural geology, as well as the progress. An intelligent boss at any time by means of these maps can get the necessary data as to a raise without hunting for the geologist.

In making reports to the head office, these maps are used to good advantage. At the end of each quarterly period the ground excavated in the stopes and drifts is outlined in black, dated, and colored with dilute yellow ink. The maps are then photographed to a reduced scale

of about ¾ in. to 100 ft., the yellow ink causing the excavated areas to appear darker than the virgin ground in the photograph. The photographs are then painted in different colors to indicate the ore-reserves and the work done by quarters for the current year. The ore-reserves are calculated for each stope and the calculations placed on the back of the picture for that stope. One set of pictures is sent to the head office and a duplicate set kept at the mine affording a permanent progress record.

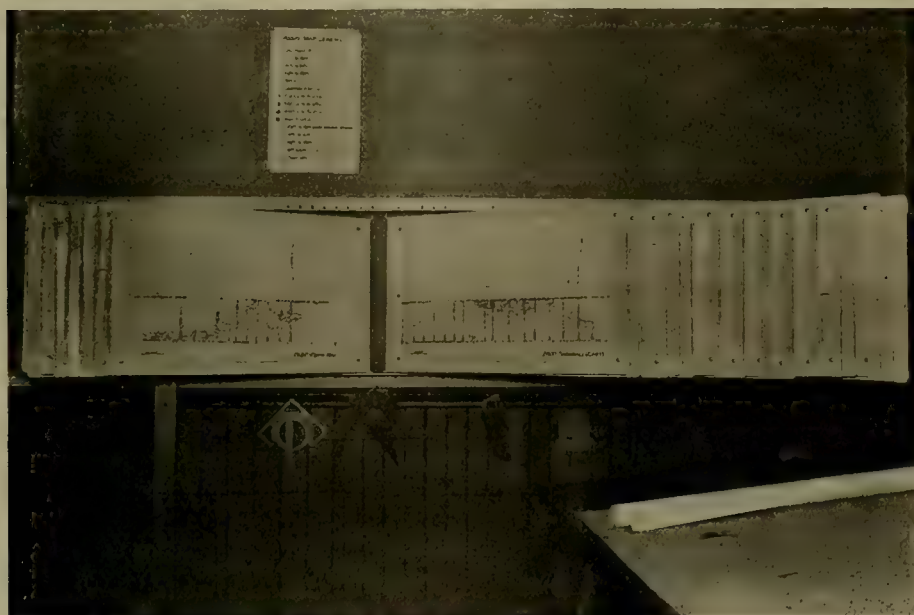


FIG. 4. ASSAY-MAP WALL-PANELS

Discrepancies in Weighing Bullion

By HARRY R. S. WILKES

*Differences between the mine weights of gold bars and those of the same bars, recorded by the buyers in England, before melting, often occur; and further differences, after melting, generally are recorded. This is, of course, well known, as is also the fact that these differences are apparently all in favor of the buyers.

The sales account usually gives three records of weights, namely: mine weight; London weight before melting; and London weight after melting.

It is with the differences between these that I propose to deal.

There are two general methods in use on the Rand for pouring gold:

(A) Pouring without slag, after skimming, and

(B) Pouring under a slag cover. The former is most suitably employed in dealing with gold of high fineness, the latter when melting gold containing much base metal.

The correct condition for pouring gold is that it be at as low a temperature as is compatible with slow pouring. The estimation of such a temperature is a matter of considerable judgment, and may be said to enter the province of the expert; at any rate the ability is only to be acquired by long and constant practice. It often happens that this condition does not obtain, because of the fear of having the metal freeze before pouring is completed. It is customary with both the methods after the metal has set, and while still hot, to quench it in water, or weak acid; in water to remove the slag and in weak acid to clean the surface before scrubbing.

The centre of the bar is the last to set, and after setting a further contraction takes place until the bar is comparatively cool. Hence a cavity is formed in the centre due to the rigidity of the rapidly cooled sides. As this cavity forms, a partial vacuum is set up, which draws into it through the centre of the top of the bar, that is, the line of least resistance, a filling; in case of method (A), of water; and of method (B), of slag, with sometimes a little water. Usually the aperture connecting with the cavity is a small one, either a fine crack or a pin hole.

In method (A) the cavity is filled with water or weak acid, and differences between local and home weights, before melting, often occur. These vary considerably, since in some bars the apertures are so small that evaporation on the voyage to England is incomplete, and also some bars are subjected to more or less heat to dry the surface before weighing. If the bars poured by method (A) are thoroughly dried, no differences between local and 'before melting' London weights should occur. When they do, they are due to weighing and clerical errors. Owing to the lengthy war period, during which accounts have not been received, precise information of differences are not available.

For many years it has been my regular practice, when

the bar has been cleaned, to place it on the hot cover of the smelting furnace for about twenty minutes. Within fifteen minutes if the cover is hot enough the contained water is expelled with some force, in jets of water or steam through the small apertures of entrance, and only when steam ceases to issue from these holes is the bar considered dry for weighing. On two occasions, it was possible, with cold bars, by injecting air with a blow-pipe, to release the contained water, which amounted in one case to 10 cc. and in the other to 15 cc. These quantities will be referred to later.

For some time after the bar has set after pouring by method (B) and while it is still contracting, the slag cover remains in a molten state, and is thus easily drawn into the cavity. If the bar is quenched in water to remove the slag, while still very hot, a little water is often drawn in as well, and completes the filling of the cavity. Of 230 consecutive bars poured by this method only 39 showed a loss on reaching London, and the average difference between local and 'before melting' London weights was only 0.037 oz. This loss, I suggest, was due to evaporation of the water filling, during the voyage, that is, the water which entered the cavity after the slag had been removed from the bar. The slag which had already partly filled the cavity of course remained unchanged during transport. Weights 'after melting' are always considerably less than those before melting, and it is sometimes assumed that this loss is solely due to the refining by oxidation during the re-melt; doubtless there is some such loss, but that it accounts for the total difference is open to serious question.

Of 22 consecutive bars poured by method (B), the average difference between the fineness estimated by assay at the mine, and that estimated by the buyers, was 0.07 milliemmes, the buyer's assay being the higher. This difference on the 22 bars amounted to 1.5 oz. in favor of the sellers. The fine gold allowed for by the buyers was, however, 16.5 oz. less than the mine estimation owing to the loss of weight in re-melting, nearly all of which may be fairly assumed to have been due to encased slag. Dip samples being taken in London, for assay, the increased value of 0.07 milliemmes in the London assays most likely represented the amount due to refining during the re-melt, which in the case of the 22 bars under consideration amounted to a total loss of weight of 1.5 oz. In support of this may be presented the fact that the weight of slag sufficient to displace 10 cc. of water is approximately 0.76 oz., and as above stated it was found possible to release 10 and 15 cc. respectively from two bars. The weights taken for assay by the buyers, and the pot scrapings, are, or should be, included in the final weight of the bar at home. From the foregoing I am led to the conclusion that an apparent discrepancy only exists between the values of the gold estimated here and those received from the buyers.

IN ADOPTING the steel helmet as a head protection the miners in the Picher zinc mining district in Oklahoma declare "Accidents take money out of the pay envelope".

* Abstract from Journal of C. M. & M. Society of South Africa.

A Modification of Horwood's Process for the Treatment of Copper-Zinc Ores

By H. L. HAZEN

The separation of the sulphides of copper from sphalerite is a metallurgical problem that has been solved successfully in comparatively few instances. Perhaps the main reason for the lack of success has been the difficulty in maintaining constant the conditions found necessary for the production of a high-grade zinc concentrate containing little copper and a copper concentrate sufficiently low in zinc to escape the penalty imposed by the purchasing smelter. Preferential flotation methods still hold out a promise, but most of these methods require a delicate control of conditions that is difficult to maintain in a mill. Another method that has received considerable attention is Horwood's, which was evolved for the separation of lead sulphide from the sulphide of zinc.

As is well known, Horwood's method consists essentially of:

First. Extraction of the sulphides from the ore in a mixed concentrate.

Second. Giving the concentrate a quick roast at a temperature ranging from 300° to 500°C. for the purpose of forming an oxide film on all the minerals except the sulphide of zinc.

Third. Re-treatment of the roasted material by flotation, the sphalerite concentrating out in a high-grade product, leaving the major portion of the other minerals in the tailing.

When applied to copper-zinc ores this method has been successful for short periods of time, a high-grade zinc concentrate and a copper concentrate low in zinc being obtained. In continuous operations, however, it has not been found possible to keep constant the required temperature in the roasting operation and the resultant flotation products could not be marketed. To illustrate: if the temperature in the furnace became too high, the sulphide of zinc was superficially oxidized and would not respond to the subsequent flotation treatment. If sulphuric acid was used to dissolve this zinc oxide off the sphalerite prior to flotation, the acid also cleaned the copper sulphides, after which flotation gave a copper-zinc concentrate and the mill-man was no better off than he was before the roast.

For the purpose of eliminating the necessity for accurate and careful control of the roasting conditions and in order always to be certain of obtaining a copper concentrate sufficiently low in zinc to escape penalty and a high-grade zinc concentrate, the following modification of Horwood's method is suggested.

First. Concentrate the ore into a mixed concentrate of all the desired minerals.

Second. Roast this bulk concentrate at a temperature in excess of 300°C. for a sufficient time to oxidize completely the copper sulphides.

Third. Transfer the roasted material to suitable equipment and dissolve out the copper sulphate formed during the roast with water sufficiently acidulated with sulphuric acid to remove whatever zinc oxide has formed on the sphalerite. The copper can be readily recovered from solution by precipitation on iron.

Fourth. Treat the residue by flotation for the purpose of extracting the sphalerite in a high-grade zinc concentrate. The flotation tailing will be a concentrate of copper containing little zinc.

The basis for this suggestion is a number of tests made on various complex base-metal ores. In every case the test was carried out in the same manner and the results obtained with each ore were so similar that the details of two of the tests made on ores from different localities will be sufficient to illustrate the results that could be expected from this treatment.

Sufficient ore was concentrated by flotation to give a mixed concentrate weighing 500 grammes. This concentrate was then placed in a roasting-dish in a muffle, which was heated until the copper sulphides were well ignited, the temperature reached being 300°C. All external heat was then removed from under the muffle and the concentrate, which was self-combustible, allowed to burn freely in a good supply of air and rabbled frequently. The temperature of the roast rose rapidly to a maximum of 470° and maintained itself there for about an hour, after which it fell gradually as the combustion neared completion. The calcine was agitated for 30 minutes with water acidulated with four pounds of sulphuric acid per

Table 1. Details of Test Made on First Sample of Ore

Product	Weight %	Assay						Distribution					
		Au \$	Ag oz.	Cu %	Pb %	Zn %	Fe %	Au %	Ag %	Cu %	Pb %	Zn %	Fe %
Original ore	100.00	5.61	2.17	2.24	0.45	11.88	19.38	100.00	100.00	100.00	100.00	100.00	100.00
Bulk-flotation concentrate ..	60.20	5.58	2.94	2.96	0.80	18.66	27.45	60.90	90.77	96.74	100.00	97.67	94.08
Flotation zinc concentrate after roast	18.51	7.03	4.26	1.34	0.30	54.48	4.74	23.68	40.51	13.57	10.64	87.65	5.01
Flotation middling after roast ..	4.66	19.02	8.36	4.47	3.45	10.50	21.71	16.16	20.00	11.41	34.04	4.26	5.75
Flotation tailing after roast (copper concentrate) ...	21.98	5.37	2.70	2.92	1.20	0.92	60.60	21.43	30.26	34.78	55.86	1.74	75.80
In solution								none	none	37.50	none	4.00	7.52

ton of calcine, the pulp filtered and the dissolved copper recovered from the effluent by precipitation on scrap-iron. The residue was transferred to a flotation machine and the sphalerite concentrated out, leaving a tailing commercially free of zinc.

The results of these tests are shown in the accompanying data. See Table 1.

As shown in the preceding table, 37.50% of the copper content of the ore was recovered as cement copper and 46.20% more obtained in a product sufficiently low in zinc to escape penalty by a smelter, making a total extraction of 83.7% of the copper in the ore. The zinc concentrate assayed 54.4% zinc and contained 87.6% of the zinc in the ore.

As a matter of interest it may be stated that another test made on the calcine showed that 80% of the copper in the ore could have been dissolved had sufficient acid been used after the roast. It will be noticed that the copper concentrate, after the flotation of the zinc, assayed slightly less than 3% copper, but under the marketing conditions peculiar to this ore it was decided that a larger profit could be made by marketing this product direct than by dissolving out the copper with acid and selling cement copper.

The results obtained in this test could have been improved both by better control in the first flotation treatment (for instance, most of the iron could have been dropped out without serious loss in the copper extraction) and by better control of the subsequent roast, as the amount of zinc oxidized and subsequently lost in solution depends upon the temperature of the roast.

Table 2. Details of Test Made on Second Sample of Ore

Product	Weight %	Assay		Distribution	
		Cu %	Zn %	Cu %	Zn %
Original ore	100.00	3.11	10.79	100.00	100.00
Bulk-flotation concentrate ..	48.76	6.03	20.77	94.64	94.88
Flotation zinc concentrate after roast	10.56	1.68	55.81	5.79	54.59
Flotation middling after roast	6.98	5.11	36.19	11.58	23.45
Flotation tailing after roast (copper concentrate) ...	19.53	6.39	4.28	40.19	7.78
In solution				37.62	8.53

It is seen in the above table that 37.6% of the copper in the ore was recovered as cement copper and 40.1% more obtained in a product low in zinc, making a total extraction of 77.7% of the copper. The zinc concentrate assayed 55.8% zinc and contained 54.6% of the zinc in the ore. In addition, a further recovery of copper concentrate and zinc concentrate would be obtained from the middling when it returned, in the normal course of milling, to the roughing-cells for re-treatment.

Probably the most serious objection to this method would be the loss of dissolved zinc, and the higher the temperature reached in the roast the greater would be the amount of zinc oxidized and dissolved from the calcine. The extraction of a portion of the copper as sulphate in solution might or might not be a drawback on account of the cost of the operation, and this would depend upon whether the zinc tailing is to be marketed as a copper concentrate or whether it would be preferable

in the circumstances to dissolve out the maximum possible amount of copper with acid and market it as cement copper.

The great advantage that it is believed this modified treatment would have over Horwood's method in the concentration of copper-zinc ores is that no great delicacy of control would be needed for the production of a high-grade zinc concentrate and a salable copper product. No matter to what temperature the roast should be taken, a day's run would not be spoiled by a zinky copper concentrate: it would merely mean that more acid must be used to clean the sphalerite and that more zinc would be lost in solution, but the copper and zinc concentrates would remain of a uniform grade.

THE PRODUCTION OF COPPER in the United States in 1919 was markedly smaller than in 1918, according to preliminary figures and estimates collected by B. S. Butler, of the U. S. Geological Survey, from all plants that make blister copper from domestic ores or that produce refined copper. At an average price of about 19 cents per pound, the output for 1919 had a value of \$243,000,000, as against \$471,000,000 for 1918. The figures showing the smelter production from domestic ores represent the actual output of most of the companies for the first 11 months of the year and the estimated output for December. A few companies gave no figures for November, but furnished estimates of the combined output of November and December. The production of blister and Lake copper from domestic ores was 1,278,000,000 lb. in 1919, against 1,908,000,000 lb. in 1918 and 1,224,000,000 lb. in 1913.

THE following are the principal taxes levied by the government of Greece on mines and mineral products: (1) an annual acreage tax of \$0.0193 per stremma (1 stremma equals about one-fourth acre), assessed on the surficial area worked; (2) a tax of 5% on the clear profits of the mines, which is to be ascertained by deducting the operating costs from the amount received from the sale of minerals (by a recent law this tax has been increased to 10%); (3) on the net profits a further tax of 1½% is levied in favor of the miners' fund, which is set aside by the Government to be used with other moneys in payment of accident claims among workers; (4) a tax depending on average profits and rental is also assessed, augmented by a tax on the amount of stamped paper used by the mines.

THE DEMAND FOR CHROMITE during the War led the U. S. Geological Survey to make special examinations of deposits of this mineral. A statement on the results of one of these examinations is contained in a 'Preliminary Report on the Chromite of Kenai Peninsula, Alaska', by A. C. Gill, just published as the Geological Survey's Bulletin 712-D. The deposits described occur at two places, both in the southern part of the Kenai peninsula. One is on tidewater at Port Chatham and the other about 16 miles inland. Large bodies of ore have been found at both places.

The First Miners and the First Civilization

By GRANT H. SMITH

The ancient and honorable vocation of mining is of such remote antiquity that Tubal Cain, "the instructor of every artificer in brass and iron", may be considered quite modern. Iron came into use not earlier than 2000 B.C., which sets a definite chronological limit upon the blacksmithing activities of the famous early descendant of Adam. The Bronze (copper) Age had its beginning in Egypt about 4000 B.C.; but underground mining for flints began in Western Europe 10,000 years ago. For the making of their fine stone implements and other artifacts, the New Stone Age men were not satisfied with the flints that could be picked up on the ground, as their ancestors had been for 50,000 years, so they began to dig for them. They were the first miners. Eighty of their worn deer-horn picks were found recently in the tunnels of the flint mines at Brandon, England. Even the skeleton of one of these early miners has been found in an old flint mine in Belgium, lying beneath a fall of rock from the roof of his tunnel, with a deer-horn pick still clasped in his hands.

The first metal-mining was done by ancient Egyptians in the copper mines of the Sinai peninsula nearly 6000 years ago. The stopes, looking very modern, are still open, and on the walls are the inscriptions of the early miners. We have their copper chisels and moils—shaped like our tools of today—their clay canteens and heavy stone picks. Already those wonderful people had discovered the art of smelting ore. Only in recent years have metallurgists succeeded in devising processes more successful and efficient. The copper-bearing ores that they dug and smelted were chiefly turquoise containing about 3½% of copper oxide; a hydro-silicate of copper; and granitic rocks bearing a small percentage of carbonate and hydro-silicate. The highest grade of ore was a hydro-silicate.

In the Pyramid Age, 3000-2500 B.C., the Egyptians invented a tubular drill, which worked on the same principle as our modern diamond-drill and produced a perfect core of hard rock. Presumably the drill was of copper, and was fed on its cutting-edge with something like emery-powder, just as those extraordinary craftsmen fed the long copper saws with which they sawed blocks of stone for their buildings and monuments. The shaft of the drill was revolved by hand by means of a crank at the top, the turning-motion being assisted by two heavy stone 'governors' swinging just below the handle.

The story of Egyptian civilization has been told a thousand times, yet the wonder of it grows with increasing knowledge. We of today owe much to Greece and to Rome—our civilization would scarcely exist but for them—but Egypt was thousands of years old and decadent

before the Greeks had emerged from the condition of simple barbarism.

Egypt was the mother of civilization. From her all of the ancient peoples learned nearly all they knew. She gave to the world agriculture, irrigation, the domestic animals, fruits and vegetables, the alphabet, paper, ink, architecture, sculpture, painting, glass-making, goldsmithing, weaving, other arts and crafts of various kinds, the mining and smelting of ores, metallic tools and weapons, the calendar, the first knowledge of the stars, the art of building sea-going ships, tools, many useful mechanical inventions, the first moral precepts, the belief in immortality, and an elaborate and efficient administrative system. All of these things she had devised and largely perfected over three thousand years B.C.

The scientific and mechanical accomplishments of the 19th century, wonderful as they are, pale beside the achievements of the early Egyptians, since they *created* mechanics and the sciences. They had no teachers; civilization arose with them.

In one domain only did the Egyptians fail to excel—that of the intellect; they produced no great philosophers and no literature of value. Their ancient code of laws has not survived.

It is almost incredible that such progress should have been made—from barbarism to a high state of civilization—in the thousand years before the 30th century B.C., yet such is the conclusion of the authorities.

Egypt traded with the then known world and carried her knowledge and progress to many peoples. Some of her trading ships ranged the Mediterranean; others traded along the coasts of the Red Sea, carrying Egyptian products and bringing back spices, gums, ivory, gold, etc. About 2000 B.C. a great canal was dug from the Nile to the Red Sea, enabling ships to pass from the Mediterranean to the Indian Ocean.

Originally, in the early ice ages, when the Sahara was a fertile plain, the present valley of the Nile was a rough fault-plane in limestone, nearly five hundred miles long, through which an enormous river rushed to the sea. Gradually the river declined in volume and the gorge silted-up; morasses and lakes succeeded, alive with great game and waterfowl, which were hunted by the Old Stone Age savages. Gradually the marshes became alluvial plains, yearly enriched by the overflowing Nile. The hunters became herdsmen, domesticating the wild animals; then learned to plant crops, then to irrigate. Irrigation demanded a settled community-life, so villages sprang up; population increased, little city-kingdoms were formed, various arts and crafts had their beginnings. With increasing community life and growing

wealth, progress in all directions was rapid. One man made himself king of all of the city-kingdoms of Lower Egypt, another became ruler of Upper Egypt. Then Menes, a great warrior and administrator, made himself king of all Egypt, and the line of Pharaohs began. This was 3400 years before Christ, according to Breasted and his school, although Petrie fixes the date at 2000 years earlier. The shorter chronology is now generally accepted.

During the Pyramid Age, 3000-2500 B.C., Egyptian civilization rose to its greatest height, from a material point of view. Professor Breasted says: "No century in the history of men, except the 19th century of our era, has witnessed as rapid an extension of man's control of material forces as the 30th Century B.C."

In all great civilizations, periods of tremendous energy and accomplishment have been followed by reaction and decline. Wealth and soft living appear to be fatal to mankind. Egypt's first period of depression set in before 2500 B.C. and lasted about five hundred years; to be followed by a notable rejuvenation in the Feudal Period, or Middle Kingdom, about 2000 B.C. Following another decline, came the invasion of the Scythians, the Shepherd Kings, who were expelled after two centuries when Egypt found herself again about 1500 B.C. Then, for the first time, Egypt became a great military power, in what is called the Empire Period; her conquests extended as far as the Euphrates. The great city of Thebes, on the upper Nile, which even in its ruins is one of the wonders of the world, is a monument to the splendor and power of this period.

The Empire lasted a few hundred years and slowly crumbled from internal decay. Egypt's sun, which had illumined the then known world for thousands of years, was hastening to its setting. In the 7th century B.C. the wolfish Assyrians ravaged the valley of the Nile, followed, after a few centuries, by the conquering Persians. Then came the Greeks under Alexander the Great, and, finally, the Romans. Cleopatra was the last of the mighty line of the Pharaohs.

What of the future of present-day civilization?

Volatilization in Assaying

By FREDERIC P. DEWEY

*It is common to blame irregular assay results upon volatilization and much has been written upon the subject, but there is no real evidence that, in a properly conducted assay, the loss of either gold or silver by volatilization is sufficient to affect appreciably the result, even when arsenic or antimony may be present. Bulk assays of flue-dust from assay muffles have been published, but the data given are totally insufficient to even approximate the volatilization from a single assay; and such figures as we have indicate the volatilization to be extremely small. Diligent search in the literature and

wide inquiry among assayers and instructors have failed to produce a single case where the litharge volatilized in making an assay has been collected and assayed for gold and silver. Having attempted to do this, with most indifferent success, I am not surprised that this has not been done.

While various textbooks give volatilization as a cause of loss in cupellation, it may safely be said that in the rare cases where this volatilization is sufficient to affect appreciably the result it is due to excessive temperature. Percy says "The loss of silver by volatilization during cupellation is very slight (unless the temperature has been much too high), and may be disregarded." This statement is repeated by the Beringers and Smith, who include gold with silver. Mitchell says the litharge fume rarely contains over one ten-thousandth of silver. Campredon says that at a proper temperature no silver is lost by volatilization.

Primarily, excessive temperature may be due to too high general temperature in the muffle; but it may often be due to temperature localized within the bead by oxidation of the metals and this may be influenced by other causes than the general temperature. I have shown an extreme case of local temperature, resulting in the burning of zinc with its characteristic flame and variations in bead temperatures with uniform pyrometer readings. Volatilization from a bath of mixed metals is not the simple question of vapor pressures of the contained metals. Based entirely upon vapor pressures, Richards, in speaking of the distillation of zinc from Parkes crust, says "Successively larger amounts of lead, silver, and gold come over the higher the temperature," but I have shown that more silver goes with the zinc in the early stages of the operation than later.

The possible volatilization of the precious metals in cupeling is a most complex proposition. It may be due to the vapor pressure of the individual metals, the vapor pressure of alloys or possible metallic compounds, of compounds of metals with metalloids or with non-metals, particularly oxygen.

Many statements regarding volatilization in assaying are based upon data obtained under conditions entirely different from cupeling and much that has been written fails to distinguish between volatilization and dusting, which is purely mechanical. In practical operations, losses are often ascribed to volatilization that are largely, if not entirely, due to dusting and other mechanical causes.

Various persons have reported the finding of gold and silver in the fumes condensed in the flues or muffles, but these generally show only minute quantities of the precious metals and all lack quantitative significance.

DURING 1919, 315 inspections were made by the Industrial Accident Commission of operations involving the safety of approximately 16,000 men employed in California's operating mines, mills, smelters, gold dredges, quarries, and construction tunnels, which work comprised underground and open-pit workings and reduction plants.

*Abstract of paper presented at the New York meeting of the A. I. M. E.

Discussion of Flotation at the Idaho School of Mines

The 'Flotation Conference' held at the School of Mines of the University of Idaho at Moscow, March 1 to 6, was attended by more than thirty visitors, and these, together with the faculty of the School of Mines and the research staff of the Federal and State Mining Bureaus, made a group small enough for good discussion and large enough to give life to the proceedings. A feature of the meeting was the liveliness of discussion. While every statement made by a speaker was scrutinized most sharply and questioned wherever doubt or ambiguity was apparent, the utmost good humor prevailed throughout. A number of phases of flotation practice was discussed in detail and certain general principles were agreed upon by the majority; not, however, without some dissenting opinion.

The main conclusions of the discussion on grinding, led by W. L. Penick of the Hardinge Co., may be summarized as follows:

(1) Ball-mills have displaced practically every other form of crushing-machine for final grinding, although it is possible that the disparity between them and chilean mills, stamp-mills, and other machines would probably not be so great if the latter, instead of depending on screens for sizing, could be run on the overflow principle and in closed circuit with a classifier, as is done in standard ball-mill practice. Cylindrical ball-mills, however, require less space than any other form of crushing device.

(2) Stage reduction is still pre-eminent and likely to remain so as long as present devices are in use. Attempts to reduce 3-in. material to 100-mesh product in one operation are inexpedient and wasteful. One-inch feed for fairly soft ore grading to $\frac{1}{2}$ -in. for the hardest ore will yield the best results.

(3) Extremes of practice in ball-mill grinding are represented by the Inspiration plant where 3-in. material is reduced to pass 48-mesh at one operation, and by the mill of the Canada Copper Co., where crushers and rolls reduce the ore to 10-mesh, after which it is ground to 100-mesh by two-stage ball-mill reduction.

(4) If some means could be found of eliminating the already sufficiently fine material from the return feed more effectively than is now done, much greater capacities could be obtained. This points to better classification in the ball-mill circuit.

(5) The peripheral speed of ball-mills should vary inversely as the fineness of grinding: 375 to 400 ft. per minute for 48-mesh product and 550 to 625 ft. per minute for coarse grinding, say, 8-mesh.

(6) Trunion-overflow mills are, in general, superior to mills with grated discharge in capacity and character of product.

C. A. Wright of the U. S. Bureau of Mines discussed flotation testing. In addition to describing standard methods, he brought out the following points:

(1) Flotation testing should be preceded by careful

mineralogic examination of ores and in many cases by segregation of the various minerals in the ore and the assay and analysis of each segregate to determine the disposition of the various metal ingredients.

(2) Intelligent use of the microscope in examination of heading, concentrate, tailing, and intermediate products; also examination by the microscope of polished sections to show mineral association are vitally important. The application of this work to certain zinc-lead ores of the Coeur d'Alene has shown that in 200-mesh particles magnified to 1-in. diam. there are particles of galena the apparent size of wheat grains imbedded in solid sphalerite and at times similar areas of sphalerite surrounded by galena. It is evident of course that nothing short of molecular dissociation can separate zinc and lead in such ores.

(3) Wet crushing preliminary to testing for flotation has generally yielded results from 5 to 10% higher than is yielded by the same treatment applied to ore samples crushed dry.

(4) Satisfactory differential flotation of zinc-lead ores of the Coeur d'Alene can be made, provided the ores are not of the character discussed in paragraph 2. Such separations show recoveries of 80%, with lead products assaying 60% lead and 6 to 8% zinc; and zinc products containing 40 to 45% zinc and 5 to 6% lead. Mixtures of No. 2 or No. 4 Barrett oils with coal-tar cresote in sodium silicate or carbonate solution generally give good results.

(5) Results secured under laboratory conditions may not be duplicated under mill conditions owing to difference in character of feed, elimination of certain substances, or inclusion of certain other substances during the milling process. The use of mill-water may give different results to those obtained by employing clean hydrant water.

R. S. Handy, superintendent of the Bunker Hill mills, though not presenting a formal paper, made notable contributions to the conference by his timely queries and comments. One of Mr. Handy's theories is that if we can eliminate the colloidal material from a pulp and then size the non-colloidal portion carefully, much better results can be secured either by gravity concentration or flotation. Indeed, Mr. Handy holds that once the colloidal material is out of the pulp it makes little difference which of the two methods of concentration is used. R. B. Elder showed in the laboratories the possibility of arranging various oils in the order of their interfacial tension with water. The first oil in the series was dropped on water and spread into a film, this film being in turn displaced by a film made from a drop of an oil of lower interfacial tension, and so on down the series. It is evident that if the same principle could be applied to the attachment of oil films to minerals, and if a definite series of 'affinities' could be worked out, we would have

made some further progress along the path of differential flotation.

An effort was made to enumerate important phases of flotation concerning which information is lacking. The following were agreed upon as needing further investigation:

- (1) Maximum and minimum size of particles recoverable by flotation.
- (2) Relation between size of bubbles and size of particle.
- (3) Relative floatability of the members of the series galena, chalcopyrite, sphalerite, pyrite, and pyrrhotite.
- (4) Influence of depth of column on effectiveness of the bubbles in collecting mineral.
- (5) Affinity or adhesion between various minerals and different oils.
- (6) Is classification desirable preliminary to flotation?

The flotation of coal was the subject of a paper by O. C. Ralston, recently appointed superintendent of the U. S. Bureau of Mines at Seattle. This paper, read by A. M. Piper, pointed out the applicability of flotation to the beneficiation of low-grade slack or culm-piles and to the recovery of coal from domestic ashes, which could be collected and brought to a central plant for treatment and recovery of the 20% of coal which it is estimated they usually contain. L. A. Grant in the absence of W. L. Ziegler, who was detained by a professional engagement, discussed the design of the Loon Lake Copper Co.'s plant in Washington, 50 miles north of Spokane. This plant, designed and built by Ziegler, although quite small in size, has attracted considerable attention owing to its compactness and simplicity. The ore consists of clean chalcopyrite in clean quartz, an ideal ore for separation. Remarkable results are reported with more than 95% recovery having been made. The equipment of the plant is ridiculously simple, consisting of a 10 by 15-in. Blake crusher followed by a 24-in. Symons disc-crusher, feeding two 4 by 4-ft. cylindrical ball-mills crushing to 65-mesh. The entire pulp then goes to a Ziegler flotation-machine that produces clean concentrate in one operation. No. 5 distilled pine-oil is used.

J. Benjamin Parker, metallurgist for the Interstate-Callahan company, in an informal address, stated that shortly before returning to the Coeur d'Alene he had had considerable success with the use of SO_2 gas in selective flotation on a small scale. The gas immediately renders the blende non-floatable, thus permitting the floating of galena in presence of sphalerite. There is some question whether the SO_2 is best added intermittently in thickeners or other storage tanks, or whether it can be used to better advantage in the flotation-cell itself. An interesting point was made by Mr. Parker on the effect in the Interstate-Callahan mill of burning sulphur in the vicinity of the zinc-flotation machine, the zinc froth being 'killed' entirely for a considerable period, to the great mystification of the mill operators.

M. H. Sullivan, metallurgist of the Bunker Hill smelter, discussed the difficulties introduced in lead-smelting practice by the necessity for handling flotation

concentrate. The main objections from the smelter's point of view are as follows:

- (1) Difficulty in unloading from cars when received at the smelter, much of the material being sticky and clinging to shovels, the wheelbarrows, bin walls, and chute gates, and being almost impossible to sample. In certain cases men practically refuse to handle some of the material sent in.
- (2) Mechanical handling of the stuff on belt-conveyors, belt-feeders, spouts, and the like is in many cases impossible.
- (3) Extreme difficulty in getting a uniformly roasted product from the Dwight & Lloyd machines. Lumps and unroasted masses are produced, thus leading to excessive matte-production and development of furnace-accretions, unless re-crushed and re-roasted.
- (4) Extra fuel consumption required to dry the material.

The remedies for these conditions would appear to lie in more careful elimination of moisture at the mills either by American filters, which were reported to be doing good work at the Hayes mill below Kellogg, or in Oliver filters, which many mills are using. The Lowden dryer is also being used at the Hayes mill with fair success. A new type of dryer devised by Elmer Brain, who is operating a tailing mill at Kellogg, was reported to be giving good results. The obvious disadvantage of paying freight on water makes evident the need of drying. From 5 to 7% was stated to be the desirable moisture content in flotation concentrate to be sent to roasters of the D. & L. type. The mixing of flotation and gravity concentrate would appear to be desirable. Unless flotation operators show a little more consideration for the smelters a penalty will have to be placed on flotation concentrate carrying excessive moisture.

Among those present were L. K. Armstrong, W. H. Linney, J. C. Ralston, and J. V. Richards of Spokane; M. H. Sullivan, superintendent of the Bunker Hill smelter, and R. S. Handy, superintendent of the Bunker Hill mills; J. B. Parker of the Interstate-Callahan and Frank H. Skeels of Wallace; W. E. Wichman, University of Washington, Seattle; Professor C. G. Warfel, Washington State College, Pullman; E. R. Abernethy, Fort Steele, B. C.; J. J. Stanford, Rocky Bar, Idaho; C. D. Dolman, Chewelah, Washington. As indicating the nature of the interchange of ideas it may be said that small operators were delighted at the advice and assistance received, and one man who stopped a job of mill-construction to attend the conference said, "what I've got here has been worth five thousand dollars to me".

TIN shipped from Potgietersrust, South Africa, in 1919 shows an increase of 183 tons as compared with the previous year. The value of the tin produced in 1918 reached the record figure of £440,995, an increase of £94,979 compared with the previous year. Tin was exported to the Argentine to the value of £20,700 and to Portuguese East Africa to the value of £9345. Small consignments were also exported to South-West Africa and Japan.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA**TRANSPORTATION BY HYDROPLANE.**

HYDER.—H. J. Bush, at one time owner of what now is the Premier mine, recently returned from England. He states that the Selukwe Gold Mining & Finance Co. has taken a third interest in three properties controlled by C. B. and H. J. Bush and associates. These properties now are administered by the Bush Mines, the B. C. Silver Mines, and the Salmon-Bear River Mining Co. It is understood that a single company to be known as the British Canadian Silver Corporation will be formed to take over the three first mentioned and that the Selukwe Gold Mining & Finance Co., which will subscribe the working capital, will take shares in the new company. These three holdings are said to embrace about 50 claims from which some high-grade ore has been taken but which have yet to be developed.

Roy Price, formerly in the employ of the Granby Consolidated Mining & Smelting Co., is behind a project to use hydroplanes from Hyder or Stewart for the transport of light supplies to the properties now under development in the Salmon River district. There are no mountains of extremely high altitude to cross along the route and in an air-line the distance is less than 20 miles. On return trips it would be possible, if the hydroplanes are a success, to bring to tidewater such high-grade ore as might be available for shipment. Ernest O. Hall, a Canadian aviator with overseas experience, is one of those interested and with him is associated E. Hubbard, of Seattle. The former states that a Seattle firm has contracted to deliver by April 15 one specially designed flying-boat and two more of the same model by May 15 next, and if these are satisfactory three more will be built for delivery on or about June 15. Each plane will have a carrying capacity of approximately 40 cubic feet.

The strike which has been interfering with operations at the Premier mine is reported to be settled, an advance of 50c. per day being granted the workmen, together with other concessions, among them the undertaking to employ a competent cook.

In the Marmot River section of the Portland Canal division there has been little mining during the past several years outside of assessment work, but the intense activity along Salmon river and high silver prices are stimulating activity. The Montana group of claims, situated in this locality, has been acquired by the Stirling Mining Co., which concern also has taken over the Grand View group of four claims. The ores of both carry silver

and lead. The Kay-Bee-Bird group, also of Marmot river, is reported to be bonded to a Vancouver syndicate.

ARIZONA**PROMISING DEVELOPMENT AT KINGMAN.**

DUNCAN.—W. O. North, former assistant manager for the United Eastern Mining Co., has purchased the dump of the old Rand mine at Searchlight. The ore will be hauled to the Duncan mill where it is to be cyanided.

KINGMAN.—The drift from the cross-cut that recently opened ore on the 450-ft. level of the Telluride mine at Oatman has opened rich gold ore. Ore was found on the 330-ft. level of sufficient grade to warrant the present deeper development. This find has caused a decided advance in the Oatman gold stocks listed on the Los Angeles exchange. The Tuckahoe mine management at Chloride has finished cutting the station at the 550-ft. level and has started drifting on the vein toward the old shaft. Ore so far developed in this work is better than that penetrated on the 350-ft. level. At a recent meeting of the stockholders at Oatman of the Oatman Consolidated Mines Co. the capitalization of the company has been increased from \$150,000 to \$1,500,000. More money is to be raised to continue the development work that is now planned.

In re-opening the Golden Star mine at Mineral Park a streak of ore was broken into on the 150-ft. level that ran 400 oz. silver and \$9 gold. A winze is to be sunk. It is announced that the Kingman Consolidated Mines Co. has been organized to take over the Arizona Buttes Mines Co. The stock in the latter is to be exchanged for stock in the former company share for share. It is reported that the Leland Mitchell group of mines is to be equipped with new machinery to develop the ground recently opened by the new 700-ft. shaft. The Gold Bug property in the Minnesota district is to be sold at auction as a result of the action of Ellen J. Crosby of Colorado Springs who has obtained an order of dissolution against the company for the purpose of settling the indebtedness. It is reported that the consolidation of the Hackberry Consolidated Mines Co. and the Senate Silver is practically certain within the next thirty days through the action of the principal stockholders of the Hackberry. Development on the 80-ft. level of the Home Pastime mine at Mineral Park has opened a body of ore. Preparations for the first carload shipment are being made.

MAYER.—The Canon Mining & Development Co., four miles north of the Kay mine, is now having its Black

Canyon, claims diamond-drilled. The first hole penetrated schist at 435 ft. and showed some copper. A second hole is now being drilled. The old Tip Top mine is being unwatered with a view to operation by the Arizona Tip Top Co. under the management of J. F. Coupal. A wagon road is being constructed to the mine to haul in machinery and other equipment.

MIAMI.—It is reported that the Gibson Consolidated Copper Co. will renew operations in about 60 days under the management of H. M. Towle Sr., the former manager. The Ray Boston Copper Co. has resumed operations on the Kelvin-Sultana property near Kelvin. It is said that exploration by diamond-drilling is to be carried out. It is reported that the Arizona Globe Copper Co., which is now developing the Cole-Goodwin property, has taken over the Independence group owned by the Independence Development Co. Some ore has been shipped to the Old Dominion smelter and the property has been leased intermittently.

PATAGONIA.—It is reported that a new three-foot vein of silver-lead ore has been opened in the Flux mine. Development is progressing rapidly.

COLORADO

REVIVAL OF MINING IN THE OURAY DISTRICT.

OURAY.—From all indications there is to be a revival of mining in this section. New leases are being drawn up from time to time, and all the operating companies are planning increased development and production. The favorable weather of the past month has been of great advantage and many operators are making an earlier start than they had anticipated. Eleven men are at work at the Portland mine. A body of ore has been opened up in the main drift. The vein is two feet wide, and extends for a distance of 1000 ft. The average value of the ore is reported to be \$25. The Paymaster mine has been leased to the Paymaster Mines Co., with the main offices at Denver. The officers of the new company are J. B. Fowler, J. E. Kelley, and John W. Cox. The Mountain Top Mining Co. has purchased the Agnes claim, owned by Thomas Mowatt, for the reported sum of \$15,000. This claim, which has been worked for the past sixteen years by the owner on a small scale, is situated in the centre of the Mountain Top group, and a vein of high-grade ore is said to pass through it.

The Eurades Mining Co., formed by Chicago capitalists, is to re-open the Des Ouray and the Benach. Development will be necessary in order to put the properties in shipping condition, and a large amount of machinery and equipment has already been ordered. The Des Ouray cross-cut will be the main operation. The Benach and other veins will also be explored. The Iron-ton mill is to operate during the coming season on custom ore.

RICO.—A statement issued by the Rico-Wellington Mining Co. confirms reports that there has been a discovery of a large body of good ore. East of the old Logan workings a vein of lead carbonate averaging six feet in thickness was opened. Under the new ruling of

the War Minerals Relief Board, the Rico Wellington company will lose approximately \$30,000, the amount of money expended in developing iron pyrite. The claim was rejected on the ground that the company was not drafted. Efforts are now under way to make a market for the material to compete with the Spanish output.

PARADOX VALLEY.—The Uranium Chemical Co. has taken over the holdings of the National Radium Products Co. The Colorado Vanadium Co. is leasing a number of claims to small operators, who are getting out a heavy tonnage of ore in the aggregate.

OPHIR.—The San Bernardo mill buildings and tramway will be completed in May. The Ruuttilla-Brown Leasing company is shipping from the Carbonero, and a force of men is at work on the Deadwood tunnel, driving toward the Favorite vein. J. M. Belisle & Co. is mining from the lower level of the New Dominion a lead-zinc product that is being shipped to the Utah smelters.

TELLURIDE.—The railroads have been blocked for several days owing to the heavy slides, and a large amount of ore has accumulated in the bins of the Tomboy and Smuggler. Illness among the miners curtailed production for the first part of the month. The Smuggler Union Mining Co. has completed operation of the Caruthers mill, of the Smuggler company, and now has plenty of water-power so that the mill can be worked at full capacity. Shipments of concentrate are being made.

SILVERTON.—The body of ore in the 'Lost Stope' of the Gold King is reported to extend down to the seventh level, a distance of 400 ft. A slide took out the power-line to the Gold King, stopping operations for a few days. The grade of concentrate is steadily improving. Todoschi & Co., sub-lessees of J. B. Giono, on the Silver Lake mines, after a long period of development are now ready to ship. The Highland Mary Leasing Co. is getting out an average of a car per week of high-grade silver ore. The Sunnyside M. & M. Co. has 58 cars of lead concentrate ready for hauling when railroad facilities are available. The Southwestern Mining Co. is getting out several cars of concentrate each week. For a short time production will be curtailed, owing to the destruction of a tower on the Iowa-Tiger tram by a snowslide. The same slide also damaged the mill to a small extent. The Gold Centre group at Animas Forks is to be developed as soon as snow will permit. The operators are wealthy oil men who will use their own capital in the development work.

MICHIGAN

SENECA SHAFT BEING CONCRETED.

HOUGHTON.—Seneca has made a third shipment of copper ore to the Baltic stamp-mill. It ran 55 lb. of copper to the ton. This is all the lode 'rock' that likely will be sent to the mill from the Seneca property for the next few months as it cleans up everything in sight. The last shipment was smaller than the first two, consisting of but five cars which were loaded from the stockpile. No lateral development now is being done. The station at the 4th level was cut this week as well as a transfer chute for

future use. Ten feet of cross-cutting to the lode has been done on the 4th level but this work is temporarily suspended while energy is directed to the job of concreting the shaft. A total of 275 ft. of this work is yet to be done. The steel timbering is all in and the skip-road laid. The forms for the concrete will be in place in a couple of days. Work of this nature cannot be hurried. The present depth of the shaft is 2145 ft. and no sinking can be done until the concrete in the shaft is set.

The unwatering of the Gratiot No. 2 shaft has been finished and the shaft opened for a depth of 1520 ft. This

shaft was re-opened a month ago. The decision not to continue this work was reached, not because of any unfavorable physical developments in so short a time, but rather on account of the difficulty in securing enough men. The shaft was opened at the 25th level. Such new openings as were made in the brief period of operation showed a general run of 'rock' quite up to the average for the northern end of the Mohawk territory. It is the belief that this No. 1 work may be resumed sometime this year, probably about July. Sinking continues at No. 4 and at No. 6 shafts and the output for the whole mine is



SULPHIDE ACID PLANT OF THE CALUMET & ARIZONA COMPANY AT DOUGLAS

is the only shaft that will be operated at the Gratiot this year, according to the present plans. It will take a month or more to get it in shape to resume sinking or to start lateral exploration work. This is the more southerly shaft and is nearer the Seneca line. A survey now is being made of the underground conditions before sinking starts. A good deal of repair work will have to be done to the skip-way and to the roof of the shaft in numerous places. The shaft is in trap for a distance of 400 ft. toward the bottom level. The diamond-drill, after cutting three holes in the Calumet conglomerate, is back in No. 1 hole again and is cutting to greater depth with the expectation of opening several other formations, particularly the Osceola amygdaloid. The drill is operating directly west of the Seneca shaft at right angles to the dip.

Mohawk has suspended operations at No. 1 shaft. This

averaging 1800 tons per day. Another battery-locomotive has been added to the underground equipment at No. 6 shaft and it is doing satisfactory work. This is the second of the battery type to be put to work in this shaft. The Mohawk has been using trolley locomotives for tramming exclusively. Mohawk is making some improvement at the stamp-mills. New re-grinding machines have been added with the result that the losses in the tailing have been reduced from 4.8 lb. to 3.6 lb. per ton. Further re-grinding experiments have led to the conclusion that more work may be done in that direction and at least one and perhaps two more re-grinders will be added with the hope of saving still more copper.

Operations in the cross-cut in the Mayflower-Old Colony property continue without change. The cross-cut now is in 50 ft. There is practically nothing of interest to report either from a viewpoint of geologic development

or mineral indications. The management is continuing its work on the policy of opening this broken area as conservatively as possible and without any unnecessary outlay to the shareholders. At the present time there is nothing in the character of the ground that is encouraging; yet it would be a serious error to discontinue this cross-cut without making the examination thorough. This work is at a depth of 1710 ft. from the surface and started from a point in the drift 100 ft. from the shaft.

NEVADA

SIMON SILVER-LEAD MINE.

MINA.—The Simon Silver-Lead Mines Co.'s property near here is a young mine, the lowest working level being approximately 400 ft. from the collar of the shaft. Yet at that shallow depth there has been exposed by drifts and cross-cuts more than 500,000 tons of ore, and the development of a really big mine is probable. Some fifty years ago when the district was remote from the railroads the property was discovered by a prospector named Story, who later abandoned it. It was re-located by another prospector named Williams. Probably Senator Bell, a pioneer resident of Nevada, who leased the ground from the owner, shipped the first ore, a lead-silver carbonate which he mined after sinking a 60-ft. shaft. This shaft is known at present as the upper shaft and is about 450 ft. from the main working shaft.

In 1916, P. A. Simon bought an interest in the property and later acquired the present holdings of the company. These consist of eight mining claims of approximately 150 acres over an area almost a mile long and from 1200 to 1500 ft. wide. The mine has been opened on six levels. These have been driven from the main working-shaft, which has attained a depth of 467 ft. Work on the tunnel-level, driven through volcanic breccia, indicates an ore deposit approximately 365 ft. long up to the east fault and the outcrop beyond this fault is known to carry ore for an additional 200 ft. This work is the earliest development work done on the property and there is still left in these workings a large amount of carbonate ore of shipping grade.

The second level was started at a depth of 80 ft. There are about 180 ft. of workings on this level. Ore shows near the shaft and in two raises, but practically all the remainder of the work has been done in oxidized vein matter. At a depth of 130 ft. the third level was driven. It has more than 500 ft. of workings, a large portion of which is in a leached material containing carbonate ore of shipping grade. The fourth level was started at a depth of 230 ft. and on this level there has been developed for a length of 120 ft. what is termed the south orebody, with an average width of about 35 ft. One shoot in this orebody is 16 ft. wide and 20 ft. long.

Two distinct orebodies have been opened on the fifth level driven from the 291-ft. point. These orebodies are separated by a mass of quartz-porphyry 25 ft. wide. The south orebody has been developed by driving three cross-cuts between 80 and 100 ft. apart and also by a drift along the hanging wall. It has an average width of 20 ft.

and the workings indicate that it extends for a distance of about 225 ft., being limited by the east and west faults. The sixth level, driven from a point 391 ft. below the collar of the shaft, shows the same orebodies that have been opened on the fifth level. The workings on this level aggregate more than 1100 ft., with more than 230 ft. of main cross-cut. Upon the resumption of sinking operations recently, the shaft-men uncovered small stringers of ore which widened to three feet.

The orebodies are large and occur as replacements in the crushed limestone adjacent to the quartz-porphyry contact and are of the type that has been developed vertically and laterally in other mining districts such as the Tintic district of Utah and at Eureka, Nevada. Operations are supervised by Burch, Hershey & White, of San Francisco, this firm at present being engaged in the design of a mill to treat the ore.

MONTEZUMA.—The Montezuma Silver Mines Co. has opened 30 in. of ore assaying from 150 to 250 oz. in the bottom of a 260-ft. inclined shaft on the Arizona claim, in the southern part of the district. A 4-in. vein in the shaft assays 100 oz. The shaft has been sunk 10 ft. in ore of this width and grade. Associated with the silver is jamesonite, a sulph-antimonite of lead said to be found in few districts in the United States aside from Montezuma. The vein is 4½ ft. wide, with a shale hanging wall and a limestone foot-wall. The find is thought to have been made a short distance above water-level and the vein is increasing in width and value. An air-compressor has been ordered and, according to the superintendent, the shaft will be continued to 800 ft. The vein strikes east and dips 50° north. The territory from 3 to 12 miles west of Goldfield, which includes Montezuma, may be on the verge of an era of prosperity, but there are no indications that conditions will be better than in other districts where capital has fled before absurd 'boosting' tactics. The Monitor group, 1½ miles from the Montezuma Silver, was to have been taken over by the Harmill Divide company for \$15,000, but it is improbable that the sale will be made, because the Harmill company asks one year in which to complete payments. Three miles west of Goldfield is the Nevada Eagle, said to be one of the best developed silver mines in the State, but the owners are silent regarding recent developments.

GOLDFIELD.—There are well-substantiated reports that a number of companies, including the Atlanta, Merger, Blue Bull, C. O. D., and Commonwealth, are to finance the sinking of a deep shaft in the eastern part of the district. In discussing with a committee of Goldfield men his intention to wreck the Goldfield hotel, George Wingfield stated that he planned to become connected with an Eastern industrial enterprise and that for this reason he desired to lessen his mining and other interests in southern Nevada. It is thought Goldfield men are planning to secure control of his companies here with the object of sinking the deep shaft. A drift is being driven in the vein on the 700-ft. level of the Kewanas and assays of \$7 are being secured. Drifting north from the main Atlanta cross-cut has been stopped because of poor results secured and a drift is being driven south

in the same vein. A cross-cut has been driven 120 ft. into the hanging wall of the vein from the south drift. A drift is being driven north in the vein on the 250-ft. level of the Blue Bull and work is to be started from the bottom of a winze from the 150-ft. level. The west drift on the seventh level of the Florence is 965 ft. long and the south-east drift on the same level is 720 ft. long. Short cross-cuts are to be driven from each to connect with old shafts for air and following this drifting will be started. The west cross-cut is thought to have passed through the Columbia mountain fault, but the management has no intention of stopping this work. Two car-loads of ore, one settled for by the smelter at \$93.17 per ton, and the other estimated to be worth \$130 per ton, have been shipped from the Development lease on the Reilly block. Sampling of the 75-ft. cross-cut recently driven through the Mohawk vein in leased territory by the Silver Pick showed the entire cross-cut to be in 'mill ore', according to Mat Murphy, superintendent. It is thought the average is \$15. The vein lies rather flat and it is 40 to 50 ft. wide. A 20-ft. raise has connected with the drift in which the original discovery was made and a drift is being driven on the hanging wall of the vein from the cross-cut. A 20-in. seam in the drift assays \$300 and in sampling the cross-cut a 4-in. vein of \$85 ore was found.

NEW MEXICO

SOCORRO PROPERTY RE-FINANCED.

GRANT COUNTY.—Radium ore has been discovered on the claims of Forster & Grissom in the White Signal mining district. The United States Smelting & Refining Co. has optioned six claims from Forster & Grissom for \$175,000 and will explore the property to determine the extent of bismuth ore also found on the property. Late in 1919 the United States company purchased the property of the Hanover-Bessemer Iron & Copper Co. in the Hanover-Fierro district consisting of concentrator, power-plant, and sundry claims containing iron and copper ores which have been producing more or less continuously for the last 25 years.

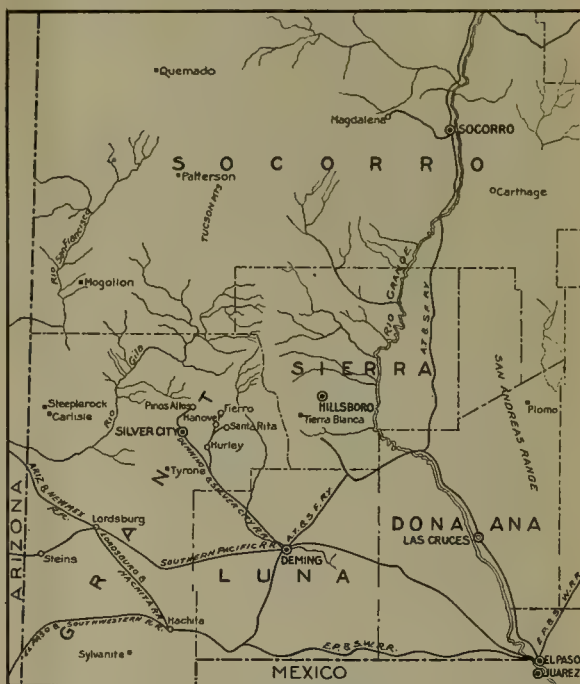
SOCORRO COUNTY.—The American Corporation of West Virginia has acquired the mine and mill formerly owned and operated at Mogollon by the Socorro Mining & Milling Co. which went into the hands of receivers late in 1918. Stockholders in the old company will receive two shares of A. C. of W. V. for five shares of S. M. & M. Co. The property consists of the Fanny, Johnson, and Cooney mines, the Fanny being the principal mine with a shaft over 1000 ft. deep. Full equipment is on the ground, including a 240-ton cyanide plant. The new company expects to start active operation within the next 60 days.

OREGON

MERCURY MINING IS PROGRESSING.

GOLD HILL.—David Force of Beagle, who has been driving a 200-ft. drift on his mercury mine in the Meadow district, 12 miles north of Gold Hill, has uncovered a large body of cinnabar ore assaying 60% mer-

cury. The new find is a typical shoot found in the mercury-bearing lode extending through this district. This vein occurs along a granite-sandstone contact, where the granite is in part pegmatitic. Most of the workings of the mine are less than 100 ft. deep. The mineralized zone is from 100 to 200 ft. wide. The ore contains cinnabar, native quicksilver, pyrite, gold, zinc, silver, and a heavy black mineral resembling meta-cinnabarite. Samples taken from several adits assay from \$5 to \$6 per ton in gold, 5 oz. silver, 2.5% zinc, and 1% mercury. The rich cinnabar ore appears all through the mass in the form of seams and kidneys. The seams are from 1 to 20 in. thick and average from 17 to 70% mercury. The Force mine is equipped with a 12-pipe mercury furnace



MAP OF SOUTH-WESTERN NEW MEXICO

and has been a producer since 1916. Considerable development work is under way and much rich ore has been uncovered in the War Eagle group, adjoining.

MEDFORD.—John Sullivan, a pioneer mine operator in the Upper Applegate district, has uncovered a rich gold-copper-silver vein eight miles north of the Blue Ledge copper mine and in a practically undeveloped part of the district. The vein is 12 in. wide and assays \$16 gold per ton; it is rich in silver and is the highest-grade copper ore ever discovered in the district. The Upper Applegate district is occupied in large part by old Paleozoic sedimentary rocks with interbedded sills or flows of andesite character. In places these bedded rocks are penetrated by dikes of dark igneous rocks and also by larger irregular masses of tonilite. The sediments in general strike about N. 20° E. and dip at a high angle to the eastward. As elsewhere shown for this entire region they have perhaps been overturned so that the oldest beds now lie above the younger.

UTAH

TAX REPEAL TO BE DISCUSSED.

SALT LAKE CITY.—A meeting of the mining committee of the Commercial Club has been called for March 19, at which time the question of urging the repeal of excess profits taxes will be discussed. The meeting was called by John M. Hayes, chairman. It is believed among mining men that the excess profits tax is responsible for much of the decrease in metal production in the United States. It is said that the dividend paid last December by the Tintic Standard Mining Co. of 23c. per share was done at the expense of more than \$100,000 in excess profits taxes to the Government. The records of the Utah metal mines on file with the State Board of Equalization for last year's operations show that very few made money and that most of them mined only 50% of their normal production. Mining men declare that many of the mines are simply being developed and ore-reserves blocked-out and left standing in the mines awaiting cheaper mining costs and repeal of abnormal taxes.

ALTA.—The Little Cottonwood Transportation Co. will be hauling ore from the mines at Alta as soon as the railroad equipment is overhauled. The operation of the railroad will be of great assistance to the various companies, as some have virtually had to stop mining because all available storage room has been filled. About 2000 sacks of high-grade ore has been mined from the shoot recently opened at the Sells mine in a drift from the 125-ft. level.

PARK CITY.—Gratifying developments are reported from the Naildriver mine. Particularly encouraging has been the work on the 600-ft. level in the drift from the Dunyon cross-cut along the north-dipping fissure. In the last 22 ft. of drifting the vein has widened from 2 ft., until, at a point 72 ft. from where the drift left the cross-cut, there is a full face of ore. Inasmuch as ore in this fissure has been opened in a winze 40 ft. above the 600-ft. level, it is anticipated this ore extends from the surface. Shipments for the week ending March 12 totaled 2212 tons as compared with 2310 tons during the previous week. The various mines produced as follows: Judge Mining & Smelting, 661 tons; Judge Mining & Smelting (premium spelter), 25 tons; Ontario, 608 tons; Silver King Coalition, 437 tons; Daly West, 308 tons; Naildriver, 120 tons; and Daly, 53 tons. The Daly Mining Co. has declared its regular dividend, No. 92, of 10c. per share payable April 1 to stockholders of record March 22. The dividend totals \$15,000 and makes the total dividends paid to date \$3,157,000.

EUREKA.—The new loading-platform near the portal of the Iron King tunnel has been completed and the company will be ready to commence shipment of iron ore just as soon as the last rails are laid on the extension of the railroad. The development of this property is said to be progressing in a satisfactory manner. While there has been little news from the Lehi-Tintic during the past few weeks, it is stated that the work in this property is going along in good shape. Fourteen mines in this district shipped 163 cars of ore during the week ending March 12, as compared with 139 during the previous week. The

Chief Consolidated had an output of 35 cars; Tintic Standard, 32; Dragon Consolidated, 27; Eagle & Blue Bell, 13; Colorado Consolidated, 14; Iron Blossom, 11; Grand Central, 7; Centennial Eureka, 6; Victoria, 5; Mammoth, 5; Swansea Consolidated, 3; Gemini, 3; Gold Chain, 1; Empire Mines, 1. One of the interesting projects at the present time is the Bull Hill. This company has put its main shaft down to a depth of 600 ft. and is now drifting on the 600-ft. level, and it seems to be generally conceded that prospects are good. The Tintic Standard Mining Co. has posted a dividend of 10c. per share payable March 29 to stockholders of record March 25. The dividend will aggregate \$117,470, and makes total dividends paid to date \$1,068,452.

BRITISH COLUMBIA

DIVIDEND DECLARED BY CONSOLIDATED M. & S. CO.

VICTORIA.—The case of the British Columbia-Wellington Collieries v. the Pacific Coast Coal Mines, Ltd., which recently was taken to the Supreme Court of Canada, has been decided in favor of the Pacific Coast company. The British Columbia-Wellington Collieries claimed \$85,000 for trespass and the unlawful removal of coal by the defendant, while the latter claimed that permission for the removal of the coal had been granted to them.

NELSON.—L. A. Biggar, a metallurgist from Montreal, has been consulting with the boards of trade and with the individual operators in the Kootenays with the object of ascertaining what support would be given to a private ore-testing and sampling works, were he to start such a plant at Nelson. His idea is to erect a plant for both laboratory and commercial ore-testing. He was given considerable encouragement. The 400-ft. tunnel at the Evening Star mine is approaching the old shaft, and work has been stopped until the shaft is unwatered.

CARIBOO.—The Lightning Creek Hydraulic Mining Co. is proving its property, near Van Winkle, with a Keystone drill. J. H. Kilmer and J. Burnett are sinking a shaft to connect with the old tunnel at the Antler Creek Gold Mines property. They will be in a position to haul gravel by the spring. A number of placer locations have been staked, and considerable activity is expected in the district next summer.

ALICE ARM.—David J. Hancock, the well known operator in this district, is authority for the statement that Sir John Carson, president and managing-director of the Crown Reserve Mining Co., of Cobalt, will visit the district with two engineers. They will examine a number of properties.

A. J. T. Taylor, president of the Taylor Mining Co., accompanied by C. M. Rolston, vice-president, and G. Nutter, representing the Minerals Separation Co., is visiting the Alice Arm district. The party proposes making a survey of the scene of this year's operations in connection with the Dolly Varden mine. Plans no doubt will be considered with reference to the additions to mine plant and railroad equipment.

PRINCETON.—The Nickel Plate mine, at Hedley, which has been closed on account of labor trouble and the gen-

eral depression in the gold-mining industry, has been reopened with 170 men on the payroll. The rise in the price of arsenic is a considerable advantage to this property. Last year the Tacoma smelter paid \$17,000 for the arsenic received in the company's concentrate.

TRAIL.—Ore receipts at the Trail smelter of the Consolidated Mining & Smelting Co. for the first week in March were 3538 tons, bringing the total for the year up to 57,384 tons. Shipments from the Rossland mines of the Consolidated company ceased with the opening of March, which was to be expected in view of the announcement that for a time work on these properties was to be confined to development. A dividend of \$261,936 has been declared by the Consolidated Mining & Smelting Co., payments to be made on April 1 to shareholders of record on March 10. The pending payment will increase the total dividend disbursements to \$6,567,211. Simultaneously with the dividend announcement comes the statement that the company has broken ground at Trail for a large new concentrator, and is considering the construction of another at Kimberley for the treatment of the ores of the Sullivan mines. The Trail mill will dress the ore of the Rossland mines. If the report regarding the latter is authentic it means that the management has decided definitely in favor of Trail as against Rossland as a site for the new plant.

COWICHAN.—The 'Hill 60' manganese mine of the Cowichan district is being equipped for uninterrupted production. An aerial tramway, designed by A. W. Davis, is being erected. It is a two-bucket balance tram, having a capacity of 30 tons in 8 hours, and is costing about \$10,000. Six towers carry the cable to the mountain-face, whence the wire runs for a span of 3600 ft. to the Esquimalt & Nanaimo railway, the total length of the cable being 4750 ft. Bunkers are being constructed both at the workings and at the railway. Since last spring about 500 tons of manganese ore has been shipped to the Billrode Alloys Co. of Tacoma. The open-cut now discloses a 25-ft. face of 50% manganese ore, although the orebody has not been extensively explored.

ONTARIO

CANADIAN MINING INSTITUTE MEETS.

TORONTO.—The 22nd annual convention of the Canadian Mining Institute, held at the King Edward hotel, March 8 to 10, proved one of the most successful and interesting gatherings in the history of the Institute. The opening address was given by Harry Mills, Ontario Minister of Lands, Forests, and Mines, who tendered a hearty welcome to the convention on behalf of the Provincial government, and outlined the policy which would be followed for the encouragement of prospectors, including a reduction of the license fee to \$5 and the providing of free assays for ores.

D. H. McDougall, president of the Institute, in his annual address referred to the frequent statement that the natural resources of Canada were 'inexhaustible' and 'unlimited' as misleading. They were not by any means as extensive as those of the United States being relatively

limited as regards the three basic requirements, namely, coal, iron, and wood. The coal deposits are largely under the bed of the ocean and their utilization is dependent on the progress of submarine mining. There were large occurrences of iron ore but mainly low in grade. The full use of Canadian resources, he pointed out, was dependent on the advance of applied science, but this was hampered by want of recognition and the inadequate salaries paid to technical experts. The Institute should urge the Government to increase the usefulness of the Geological Survey by providing a larger appropriation.

James McEvoy presented the report of a committee



ALTA, UTAH

appointed to consider the status of the engineer, reviewing proposed legislation on the subject. The opinion was expressed that legislation, which might be suitable to other branches of the profession, would not be acceptable to mining engineers. Restrictions which would prevent investors employing men in whose judgment they had confidence to make investigations would not be desirable and would tend to discourage mining investments.

M. E. Wilson described the molybdenite occurrences of the Ottawa valley, where, though the demand had decreased since the War, some companies were still carrying on operations. The future of the industry depended altogether upon the demand. The principal feature of the evening session was an illustrated address by J. C. Nicholls, general superintendent of the International

Nickel Co. of Canada, describing operations at the Creighton mine at Sudbury.

At the morning session of the second day F. W. Gray, of Montreal, spoke on the coal supply of Canada pointing out that transportation difficulties were an obstacle in the way of sending Nova Scotian coal to Ontario to compete with American coal. The solution of the problem was the deepening of the St. Lawrence canals. E. Stansfield, of Ottawa, discussed the principles and practice of fuel briquetting. A smoker and concert was held in the evening which was largely attended.

C. E. Macdonald on the following day gave an address advocating the use of nickel for the coinage of 5 and 10-cent pieces in place of silver. A discussion on the subject followed which resulted in the adoption of a resolution moved by T. W. Gibson and seconded by A. J. Young of North Bay requesting the Council of the Institute to take the matter up with the Dominion government and enlist the support of members of Parliament. J. G. McMillan spoke on 'Recent Developments in Mining in Northern Ontario', noting the changes brought about by the increase in the price of silver that have rendered it profitable to treat ore formerly classed as waste, and by the general adoption of the flotation process. The following officers were elected: O. E. S. Whiteside, president; E. E. Campbell, W. J. Dick, H. Y. Russell, and D. H. McDougall, vice-presidents.

The annual banquet held in the evening brought the convention to a close, the principal speakers being Harry Mills and Bradley Stoughton, secretary of the American Institute of Mining and Metallurgical Engineers, who brought the cordial greetings of that organization and expressed the hope of closer co-operation between the engineers of Canada and the United States.

The following day about 130 of the members paid a visit of inspection to the new nickel-refinery of the International Nickel Co. of Canada at Port Colborne, returning to Toronto in the evening.

PORCUPINE.—The mining companies have voluntarily increased miners wages in this camp and in Kirkland Lake, the new scale, which goes into effect this week, giving muckers and loaders \$4.25 per day and miners \$4.75, with increases to the mill and surface men. The increase averages about 50c. per day. The prices on goods at the Porcupine mine stores have also been cut about 20%. It is expected that these concessions will considerably relieve the labor situation and attract many needed workers to the camp. The shareholders of the Dome Extension have ratified the proposal of the directors to extend the option held by the Dome Mines to September 15. The terms of the agreement are continued, under which the Dome must spend at least \$3000 per month on development. According to an official statement for the period between the re-opening of the company's mill in June last and the end of December, the Dome treated 187,580 tons of ore, averaging \$7 per ton, with a total recovery of \$1,290,301 or \$6.87 per ton. The Porcupine Crown is making active preparations to resume operations. The mill has been placed in running order and a force of men

has been taken on. There is sufficient broken ore to keep the mill in operation for six months.

KIRKLAND LAKE.—The area of this camp is being considerably extended to the east where a number of new companies are developing claims for several miles beyond the known gold-bearing zone. The geological formation of this new section presents the same characteristics as prevail where the mines are situated, and surface indications are promising. Some mining men are of the opinion that this will finally prove one of the most extensive gold-producing areas in Canada, stretching eastward through Lebel township as far as Larder Lake. At the Canadian Kirkland the shaft is down 180 ft. and cross-cutting is under way at the 150-ft. level. The Ontario Kirkland has opened up a vein of \$20 ore on the 300-ft. level for a considerable distance. The Argonaut, formerly known as La Mine d'Or Huronia, situated on Beaverhouse lake is carrying on development, having proved up a substantial tonnage of commercial ore. Drifting operations are under way at the 200-ft. level, where an ore-body over 100 ft. long has been developed averaging \$9 per ton over a width of several feet. A large cyanide mill will be built.

COBALT.—Hugh Park, manager of the Nipissing mine, announces that during February the company mined ore of an estimated value of \$307,485 and shipped bullion from Nipissing and custom ores of an estimated net value of \$409,523. Regarding development work, he states: "The most important development of the month was the cutting of vein No. 230 by a cross-cut being driven to connect No. 63 shaft and No. 96 tunnel. Two veins were found, within six feet of each other, one being one inch wide and the other two inches. The intervening country-rock contains appreciable amounts of argentite, native and ruby-silver. The veins are not particularly high-grade, but are strong and show fair amounts of leaf-silver and cobalt. The development is important, as the cross-cut is just above the Keewatin contact, which, at this point, is 225 ft. from the surface. A cross-cut 90 ft. higher up and 110 ft. distant also opened milling ore in a disturbed zone, which may ultimately prove to be part of vein No. 230."

Since commencing a new development scheme near the close of 1919, the Chambers-Ferland mine has developed \$150,000 in ore, and is now making regular shipments to the Dominion reduction plant. The Beaver Consolidated is steadily adding to its known reserve of medium-grade ore, as well as mining a small tonnage of high-grade. Mining and milling costs have been reduced to between \$8 and \$9 per ton, or less than 50% of the average mill-heads. During February the Hargraves Consolidated commenced to ship ore, and with a force of 10 men sent out 210 tons of low-grade material, averaging between 12 and 15 oz. per ton. In its lower workings, the Mining Corporation of Canada has installed an electric pump with an automatic starter, by which the several mines of the company are all being kept free from water. An old stope, about 800 ft. long, 9 ft. wide, and 60 ft. deep is being used as a sump to which water from the several properties has a natural flow.

THE MINING SUMMARY



CALIFORNIA

Amador County.—In order to control the fire that has been raging for several weeks in the Kennedy mine, operations today were suspended in the Argonaut mine and the flooding of the property commenced. Work had already been discontinued in the Kennedy and water was started pouring into that mine. In the Argonaut 250 miners have been laid off. In the Kennedy 150 miners are out of work. According to N. F. Kelsey, superintendent of the Argonaut, the two properties face a shut-down of from five to six months. It will take that time to flood the workings, extinguish the flames, and unwater the properties so that mining operations may be resumed.

The fire started in the Argonaut more than a year ago, but was controlled so that work was resumed there. The fire was believed under control and confined to workings no longer used, but recently it burst through into the workings of the Kennedy mine. First efforts toward stamping out the fire apparently were successful until bulkheads put in on the 3100 and 3300-ft. levels failed, and it was found the last resource of flooding the workings would be necessary.

IDAHO

Coeur d'Alene.—The Consolidated Interstate-Callahan Mining Co. proposes to change its name, according to reports issued from the New York office. The title proposed is the Callahan-Zinc-Lead Co. Shipments from the mine since January 1 show improvement resulting from the changes made in the mill last summer. A better separation of the lead and zinc and a closer recovery is being obtained. During January the company shipped 4200 dry tons of zinc concentrate averaging 50% zinc and less than 4% lead. Formerly the lead content was 8 to 9%. During the same months shipments of lead totaled 1600 tons, establishing a new record. The lead concentrate averages about 20 oz. silver. During February some time was lost, but the value of the shipments was higher than in January.

Elmore County.—The Boise Rochester mine, taken over by H. B. MacGowen, is under the capable management of Thomas L. Chapman. The company has spent the past two years prospecting and developing the mine, getting it in shape for operation. Large bodies of ore ranging in value from \$4.50 to \$16 per ton have been exposed for widths of from 10 to 15 ft. A cross-cut tunnel will cut the vein several hundred feet deeper than the old workings. This tunnel is being driven with power-drills, making from 10 to 12 ft. every 24 hours. The new tunnel will open up large bodies of good milling ore and give several hundred feet of backing between it and the bottom of the old workings. The company has been making tests on its ore with the view to erecting a new mill to extract the gold and silver.

The Minerva Mining & Milling Co.'s property is now under the management of C. E. Stevens, trustee. Mr. Stevens has had considerable experience in the Atlanta district and is opening up this mine in good shape. A winze has been sunk from the lower workings, from the bottom of which drifts have been run both east and west for several hundred feet. In the west drift large bodies of ore showing free gold have been exposed.

The Big Lode mine, which has been idle for ten years, is now being operated by the Boston Idaho Milling Co. under the management of W. R. Prentis, who placed both the mine and mill in active operation within 60 days. This property was worked quite extensively some years ago on the surface and down to a depth of 75 ft., producing some rich ore. The company expects to build a cyanide plant this spring just as soon as weather conditions will permit. The ore contains considerable sulphide in addition to the free-milling gold.

Halley.—The biggest discovery ever made in this district was reported recently in the North Star mine of the Federal Mining & Smelting Co., which is on the east fork of the Big Wood river, about six miles from here.—Arrangements have been made to build a concentrator at the Golden Glow mine. Milling machinery is being bought. The road will be repaired to facilitate the movement of machinery from the railroad to the mine.

MISSOURI

Joplin.—The Metals Extraction Corporation of America, which is equipping a plant for the manufacture of zinc oxide at the Old Rock distillery, expects to have the plant making a product for market by April 15. The furnaces and other equipment will be put into operation a few days before that time, but it is the plan to allow several days for inspection and adjustments, if necessary, to ensure turning out a high-class product. The plant will start with one twin furnace, which will produce about 7000 lb. of zinc oxide per day. Other furnaces will be started later and it is expected by July the plant will be going at full capacity, turning out 80,000 lb. per day. Zinc oxide will be made here under a new process, that is said to greatly reduce the time required under old methods. The process is the invention of A. Schwarz who perfected it during his five years residence in the Joplin district. He says the plant will produce zinc oxide in 30 minutes instead of the many hours needed by old methods.

The plant is being equipped with many labor-saving devices and will be highly efficient when completed. The company is a \$1,200,000 concern, composed largely of New York City capitalists.

The Iowa Mining Co., which has a 46-acre lease two miles south of Baxter Springs, has purchased a 150-ton mill and is moving the plant to its lease. The Iowa lost all its equipment, consisting of engine and boiler-rooms, derrick, hoisting and pumping machinery, when fire broke out in the plant last fall. After adjustments were made with the insurance company the place was cleaned up and new hoist and pumps purchased. The mine is regarded as one of the richest in the district and the shaft now is in a fine body of ore, which is being hoisted and thrown on the dump, awaiting the erection of the mill.

MONTANA

Butte.—At the old Champion mine near Deer Lodge a first-class hoist, mounted on a concrete foundation, has been installed; a new head-frame replaces the old one; shaft compartments have been re-timbered to the water-level; a receiver getting air through a 2500-ft. air-line from the lower tunnel furnishes sufficient pressure to keep the water spouting out of a 6-in. water-column, and furnishes enough power to operate the hoist. The Butte-Jardine company,

operating the property, has purchased and installed more than 80,000 lb. of machinery at the mine. A 150-hp. motor and compressor, one 54 by 16 in. receiver, a large hoist, and an 80,000-volt transformer are included in the equipment at the plant. Lumber is furnished from a saw-mill purchased by the company last fall.

NEVADA

Divide.—The Tonopah Divide meeting has again been postponed, this time indefinitely, because of the illness of H. C. Brougher, president of the company.

Goldfield.—It is reported that the Development company's mill will start on a small tonnage April 1.

Marietta.—Silver ore from 1 to 6 in. wide and assaying more than 6000 oz. has been found in a 30-ft. shaft on the C. & A. claims, 35 miles south-west of the Simon district. A sample taken from a width of two feet gave an assay return of 200 oz. silver, 45% copper, and 5% lead. A shipment of 715 lb. gave a smelter return of \$1.67 per pound.

Pioche.—Practically no deep mining has been done in the district. The deepest shaft is down but 1400 ft. Men who are familiar with the geology and mineralogy of the locality are confident that the possibilities of many of the old mines, with deep operations, are promising. Pioche is taking on new life with the rapidly increasing activity. Shipments have averaged for a considerable period 2500 tons of ore per week. Last week 3000 tons was shipped. The Virginia-Louise has a contract to furnish 1000 tons of ore per week to Salt Lake valley smelters. In order to handle this tonnage economically, officials of the company are in the East arranging for the purchase of new equipment. At the Combined Metals, a large tonnage of silver-lead-zinc ore has been blocked out. The Pioche Mines Co. has taken over the Nevada Volcano mines, which include the Stindt-Donohue and the Big Five leases. Milling experiments on the treatment of the ores of this property are being made by the company at the old Yuba mill near the railroad depot. By mixing the ores mined at the Nevada Volcano property with ores from the Nevada Mines an excellent concentrate can be made.

NEW MEXICO

Santa Rita.—The new mill of the Grant County Copper Co. is being operated, and shipping will begin in the near future. The Chino Copper Co. is working about half of its normal force in the pits; everything is held in readiness to resume work with a full force at any time conditions warrant.

Silver City.—The Silver Spot Mines Co. has its shaft on the Boston Hill down 100 ft. and it has been in iron ore almost from the first. It is stated that shipping of iron-manganese ore could begin at any time, but that it has been decided to continue sinking before any cross-cutting is done.

Socorro.—The Mogollon Mines Co. is shipping silver bullion regularly every ten days or two weeks. A recent shipment of 20 bars, valued at \$35,000, was sent to New York.

WASHINGTON

Northport.—Ore is being shipped regularly from the Electric Point mine. The tramway is being operated continuously throughout the day and the operations in the mine are proceeding day and night.

Okanogan County.—Activity is reported in the Oroville district. The Kaaba is ready to ship ore according to J. W. Douglas of Spokane. The ore, which contains copper, silver, and lead, is improving with depth. The shaft will be continued to 1000 feet.

MEXICO

Cananea.—Hoisting from the 700-ft. level of the Carnegie Lead & Zinc property is now in progress and the mill is running smoothly. Two cars of zinc ore and one of lead and copper concentrates have been shipped.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

W. F. Stevens has returned to Long Beach, California, from Denver.

D. D. Moffat, consulting engineer of mills for the Jackling porphyry properties, is at Duluth.

Oscar M. Bilharz, of St. Louis, who is sojourning at Santa Barbara, was in San Francisco last Monday.

Bulkeley Wells spent part of last week at Grass Valley, where he is re-opening the old Idaho and Maryland mines.

G. A. Joslin, managing engineer for the Ramshorn Mines Co., has returned to Salt Lake City after a brief vacation in southern California.

R. G. Knickerbocker has been appointed metallurgist to the Messina Development Co. in the Transvaal and has left New York on his return thither.

E. Gybbon Spilsbury has returned from Brazil, where he has spent the last few months in examinations of iron and manganese resources and possibilities of utilizing native coal for reduction.

J. T. Shimmin has resigned his position as mill manager for the Arizona Hercules Copper Co., to take charge of the new mill for the Iron Cap Copper Co., at Copper Hill, Arizona, but he has been retained in a consulting capacity in the concentrating department of the Arizona Hercules Copper Company.

Obituary

Julius Thompson died at Anchorage, Alaska, on February 2. He was born near Milwaukee, Wisconsin, one of the ten children of a Methodist minister. He educated himself and graduated at Lawrence University, Appleton; he sawed wood and did odd jobs, often living on only crackers and cheese, in order to complete his education. He then studied law with a prominent firm at Chicago, and practised law until the Chicago fire of 1871 destroyed his library and office. Then he went to Joplin, Missouri, becoming interested in lead mining and building a smelter. Later he erected zinc-furnaces at Weir City, over the line in Kansas, where the coal was, these being the first zinc-smelters in the district. A severe slump in the price of spelter, when he had several months stock on hand, broke him. He then returned to Milwaukee, and was with the North-Western Mutual Life Insurance Co. for several years, as examiner of titles and abstracts on loans. On account of his health he went to Rico, Colorado in 1880, outfitting with a six-mule team at the terminus of the railroad at Alamosa, Colorado. At Rico he practised law and engaged in mining. In 1892 he helped to sell the Enterprise mine from David Swickheimer to Posen & Crawford for \$1,100,000. He then left the San Juan and became interested in real estate at Salt Lake City, where he lived for a few years. At this time he purchased the Yellow Jacket mine, in Lemhi county, Idaho, which he sold to John F. Searles, of New York, in 1895. The Judge lived at Cripple Creek from 1895 to 1900, when he went to Nome, Alaska, remaining there a couple of years. He presented the indictments against Judge Noyes, who was eventually sentenced to the penitentiary by the San Francisco Court of Appeals. He then moved to Yakataga and Katalla, Alaska, operating some ocean-beach gold-placers at the former. In 1916 he moved to Anchorage, Alaska, the Government town, on the railroad being built by the U. S. Government. The Judge was 80 years old at the time of his death; he leaves a widow and one son, Arthur G. Thompson, an attorney, at Anchorage. In 1864 he married Charlotte Sheldon, at Climax, Michigan.

THE METAL MARKET



METAL PRICES

San Francisco, March 23

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11.50
Copper, electrolytic, cents per pound.....	18.75
Lead, pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$142
Platinum, 10% iridium, per ounce.....	\$162
Quicksilver, per flask of 75 lb.....	\$90
Spelter, cents per pound.....	10.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 22.—Copper is more active and steadier. Lead is quiet and easier. Zinc is dull and erratic.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York			London	Average week ending		
Date	cents		pence		Cents	Pence
Mch. 16.....	118.00		67.87	Feb. 9.....	132.50	87.89
" 17.....	121.00		65.75	" 16.....	132.10	85.72
" 18.....	122.00		68.25	" 23.....	130.00	83.55
" 19.....	124.00		70.82	Mch. 1.....	129.87	82.75
" 20.....	126.00		72.62	" 8.....	130.37	81.13
" 21 Sunday.....				" 15.....	121.90	72.14
" 22.....	129.50		77.00	" 22.....	123.42	70.35
Monthly averages						
	1918	1919	1920		1918	1919
Jan.	88.72	101.12	132.77	July	99.62	106.36
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12	.....	Sept.	101.12	113.92
Apr.	95.35	101.12	.....	Oct.	101.12	119.10
May	99.50	107.23	.....	Nov.	101.12	127.57
June	99.50	110.50	.....	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

New York			London		
Date	Cents	Pence	Date	Cents	Pence
Mch. 16.....	18.25		Feb. 9.....	19.12	
" 17.....	18.12		" 16.....	19.00	
" 18.....	18.00		" 23.....	19.02	
" 19.....	18.00		Mch. 1.....	18.81	
" 20.....	18.00		" 8.....	18.62	
" 21 Sunday.....			" 15.....	18.37	
" 22.....	18.25		" 22.....	18.10	
Monthly averages					
	1918	1919		1918	1919
Jan.	23.50	20.43	July	26.00	20.82
Feb.	23.50	17.34	Aug.	26.00	22.51
Mch.	23.50	15.05	Sept.	26.00	22.10
Apr.	23.50	15.23	Oct.	26.00	21.66
May	23.50	15.91	Nov.	26.00	20.45
June	23.50	17.53	Dec.	26.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending			
Mch. 16.....	9.37		Feb. 9.....	8.75		
" 17.....	9.25		" 16.....	8.75		
" 18.....	9.00		" 23.....	8.92		
" 19.....	9.00		Mch. 1.....	9.18		
" 20.....	9.00		" 8.....	9.43		
" 21 Sunday.....			" 15.....	9.50		
" 22.....	9.00		" 22.....	9.10		
Monthly averages						
	1918	1919	1920			
Jan.	6.85	5.60	8.65	July	8.03	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78
Mch.	7.26	5.24		Sept.	8.05	6.02
Apr.	6.99	5.05		Oct.	8.05	6.40
May	6.88	5.04		Nov.	8.05	6.76
June	7.59	5.32		Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	
Mch.	85.00	72.50		Sept.	80.40	55.79	
Apr.	85.53	72.50		Oct.	78.82	54.82	
May	100.01	72.50		Nov.	73.67	54.17	
June	91.00	71.83		Dec.	71.52	54.94	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	New York		London	Average week ending	
	cents	pence		Cents	Pence
Mch. 16.....	8.85		Feb. 9.....	9.07	
" 17.....	8.75		" 16.....	9.06	
" 18.....	8.90		" 23.....	9.25	
" 19.....	9.10		Mch. 1.....	9.20	
" 20.....	8.95		" 8.....	8.98	
" 21 Sunday.....			" 15.....	9.06	
" 22.....	8.90		" 22.....	8.91	

QUICKSILVER

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.58	July	8.72	7.78	.....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	.....
Mch.	7.67	6.53	.....	Sept.	9.58	7.57	.....
Apr.	7.04	6.49	.....	Oct.	9.11	7.83	.....
May	7.92	6.43	.....	Nov.	8.75	8.12	.....
June	7.92	6.91	.....	Dec.	8.49	8.69	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	New York		London	Average week ending	
	cents	pence		Cents	Pence
Feb. 24.....	80.00		Mch. 9.....	80.00	
Mch. 2.....	85.00		" 16.....	85.00	
			" 23.....	90.00	

QUICKSILVER

	1918	1919	1920		1918	1919	1920
Jan.	128.08	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	....	Sept.	120.00	102.80	....
Apr.	115.00	73.12	....	Oct.	120.00	86.00	....
May	110.00	84.80	....	Nov	120.00	78.00	....
June	112.00	94.40	....	Dec.	115.00	95.00	....

MONEY AND EXCHANGE

The 'Commercial & Financial Chronicle', in discussing the foreign exchange situation, says:

"The complete reversal which has come about on the foreign exchange market, on the stock market, and in the price of gold and silver bullion at London, is evidence of the change in financial sentiment which the recent incidents have caused. There can be no doubt that a very great number of our own people have for a considerable time been confusing depreciation in exchange on a given country with impairment of that country's national credit. The two things are not at all necessarily connected. If Western Europe were actually 'bankrupt'—to use the off-hand remark which became so familiar a few weeks ago—or if insolvency was visibly impending, then undoubtedly exchange on Europe would depreciate rapidly. But it does not by any means follow that if exchange on London or Paris is falling violently, therefore England or France must be insolvent or about to become so. The depreciation in exchange may be due, and usually is due, to causes wholly apart from public credit—as it was, for instance, when an exactly similar depreciation in European exchange on New York occurred in August and September of 1914. The United States was certainly neither bankrupt nor threatened with bankruptcy when sterling was quoted at \$7 in August of that year; or, for that matter, when gold sold at 285½ in New York in our paper inflation days of 1864.

"A memorandum of the Supreme Council takes account of these circumstances. It recognizes that the double influence of work on the depreciated exchange and the abnormal excess of imports over exports in the recent belligerent States of Europe and the inflation of European paper currencies not payable on demand in gold, and it sets forth as essential 'that early steps be taken to secure the deflation of credit and the currency', and that this must be done, first through 'the full resumption of peace-time industry'; second, through 'suppressing extravagance and reducing expenditure'; and third, through securing 'deflation of credit and currency', alike by reduction of public expenditure to the limits of public revenue and by imposing new taxes where necessary for that purpose, and by 'immediate limitation and gradual curtailment of note circulation'.

"That this is a sound conclusion, the actual facts regarding the course of economic events in Europe are evidence. The extraordinary increase in England's export trade, especially to other countries than the United States; the consequent great reduction in her recent yearly increase of imports over exports; the tangible data regarding the reconstruction already accomplished in the case of the ruined French industries and the resumption of the partly abandoned French agriculture; the failure of all recent efforts at Bolshevism in labor, or at paralysis of European industries through a general strike—these are but a few of the reassuring indications. What is most striking of all, however, is that these signs of increased political, industrial, and economic stability are occurring at the end of a hard winter, which, it had been taken for granted, would test to the uttermost the staying power of European institutions under the existing strain.

"A great part of the trouble and delay in doing away with the mischief of demoralized trade and currency inflation in older historic episodes of this sort has arisen from the deliberate refusal of governments, and sometimes of the banking community also, to face the situation either honestly or courageously."

Foreign quotations on March 23 are as follows:

Sterling, dollars:	Cable	3.82½
	Demand	3.82
Franc, cents:	Cable	6.95
	Demand	6.93
Lire, cents:	Demand	5.00
Marks, cents:		1.98

Eastern Metal Market

New York, March 17.

The markets are all quiet with prices generally lower and demand of small proportions.

Copper buying is light and prices of all sellers are lower.

The tin market is quiet and stale with speculative dealings predominating and consumers uninterested.

The lead market is quieter and barely steady with prices slightly easier.

Values of zinc have been highly erratic under the influence of the London market. Buying is decidedly moderate.

Antimony is quiet and easier.

IRON AND STEEL

Reports from the leading steel-producing centres still dwell on the struggle with short coal-supply and with scarcity of cars and motive power, says 'The Iron Age'. Similar reports prevailed throughout February and yet the official statistics given out in the past week show steel-ingot production in that month averaging 142,000 tons per day, or almost a record rate. The trade is frankly surprised at these figures, in view of existing handicaps.

New activities of labor organizers at various steel-works districts, including Gary, are a subject of comment in the trade and latest strike plans are presumed to centre about May 1. Reports of preparations for a second strike have been circulated for several weeks, but the willingness of workers to repeat so soon their heavy sacrifice of wages is doubted.

The situation as to automobile sheets remains unaffected by the increase in ingot production. Notwithstanding various reports the Steel Corporation still adheres to the finished-steel prices of March 21, 1919.

COPPER

Demand continues light and inducements are necessary to promote buying. Quotations have further receded until now electrolytic copper is quoted by first and second hands, large and small producers, at 18.25 to 18.37½c., New York, for deliveries up to July. One large seller remarked yesterday that unless one really wanted the metal he would not advise an offer of 18c., New York. Lake copper is quiet and easy at 18.37½c., New York. Outside buying is extremely light, but there is an under-feeling of confidence that a buying movement will appear soon to meet the needs of consumers for May-June and perhaps later deliveries. Analysis of the 1919 copper export shows that the total was 438,165,800 lb., or only about 40% of the peak of the war movement in 1917, and less than 50% of the exports of 1913, namely, 926,241,000 pounds.

TIN

The market is flat, dull, and stale and has been all the week. It continues to have a highly speculative nature and all the transactions have been between dealers and traders, consumers still remaining aloof. As soon as the latter come in as buyers the speculative phase of the market will probably disappear. These speculative dealings have been put through irrespective of actual values and conditions. It is believed that spot tin is more concentrated and in stronger hands with the cheap sellers being gradually eliminated. Spot is sold as high as 63.75c., New York, in the week, but yesterday had fallen to 62.25c., New York, due partly to a decline of £11 10s. per ton in the London market, which continues highly speculative. Today the London market fell another £14 to \$358 per ton. Yesterday spot Straits was quoted at £372 per ton, which contrasts with £411 two weeks ago and £418 as the high mark a little earlier. Arrivals thus far this month have been 1035 tons, with 5085 tons reported afloat.

LEAD

The market is quiet, dull, and barely steady, with quotations slightly lower, due to easier conditions obtaining in the case of a few producers. While most producers are still striving hard to obtain enough lead to meet contracts, some others are less pressed. There were offerings yesterday of prompt shipment from the West at 9.37½c., New York, which we quote as the market. More metal is being offered for April and still more for May shipment. There is also more lead in transit available as well as some re-sale lots from consumers. There is definite evidence now that increased production is being felt. The London market is receding, quotations being off £2 yesterday from the day before and prices are considerably lower as compared with those a week ago. On March 9 spot lead was quoted in London at £50 5s. and futures at £53. Yesterday these positions were £45 and £47 per ton, respectively.

ZINC

Prices have been erratic all the week and often each day, values in the morning often being at great variance with those later in the day. This has been due largely to conditions in the London market where speculation is a big factor. On the dip in values about a week ago there was a fairly large amount of buying by domestic consumers and by exporters. This quieted down as the week advanced until now the market is quiet and inclined to be easy. Yesterday prime Western for shipment up to July was obtainable and offered as low as 8.50c., St. Louis, and 8.85c., New York, which we quote as the market, but sales by one producer of prominence were made at 8.60 and 8.62½c., St. Louis, or 8.95 and 8.97½c., New York, for fairly early shipment. There is only a fair demand for either foreign or domestic account. Japan is largely absent as a factor.

ANTIMONY

The market is quiet and lower, due to less demand and the appearance of some re-sale lots. Wholesale lots for early delivery are quoted at 11 to 11.25c., duty paid.

ALUMINUM

Virgin metal from the leading producers is held at 33c., New York, for wholesale lots for early delivery. From outside sources it is quoted as low as 31c.

ORES

Tungsten: The market is inactive and apparently awaits some action on the tariff, although some insist that the bill will never become a law. Quotations range from \$6.25 per unit for Chinese ore to \$15 for high-grade domestic ore.

Ferro-tungsten is obtainable at 80 to 90c. per pound of contained tungsten.

Molybdenum: Only a little business is reported, with values at 75c. per pound of MoS₂ in regular concentrates.

Manganese-Iron Alloys: Domestic producers of ferro-manganese have advanced their prices to \$180, delivered, for last half. Before this some 2000 tons was sold for delivery in March and later, all domestic alloy, part of it from a recent new producer. For the March business \$230, delivered, was obtained, a new high figure since the Armistice. For second quarter \$200 was the figure and for later and last-half business around \$175 was obtained. Almost no British alloy for any delivery is now available. On a recent inquiry from California for a few hundred tons a British maker bid \$212, delivered, but the business was not considered. The spiegeleisen market is stronger at \$60, furnace. While domestic demand is light just now, foreign business is large, there being from 15,000 to 20,000 tons under negotiation.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

THE WELLMAN-SEEVER-MORGAN COMPANY RAILWAY CAR-DUMPER

Car-dumpers are employed for discharging the contents of open-top railroad cars by inverting the car sidewise and dumping the contents into boats, bins, or storage yards. Car-dumpers may roughly be divided into two general classes—the turnover type, which does not lift the car except to turn it about on axis, and the lifting type, which elevates the cars for discharging direct into vessels or into high storage-bins. The turnover type has been developed in

movable car-dumpers, while the stationary turnover-type is operated by steam or electricity as preferred. Most of the lifting type of car-dumpers are operated by steam, although some installations have one or two of their functions electrified. There is at present a growing tendency toward complete electrification of this type on account of greater operating economy. It is not, however, always convenient to produce or secure the necessary electric current and then great economies may be secured from steam operation. If electric power is used it is always direct current. During



Dumper for Standard Railroad Cars

stationary and moving machines. Recent models overturn and dump two railroad cars at once.

All types consist essentially of a rectangular framework supporting a rotating cradle in which the loaded railroad car is held while discharging. An entirely automatic counterweight device clamps the car to the cradle which is inverted by the revolving mechanism, carrying the car with it. The top of the cradle forms a chute for directing the material as it flows out. While most of the recent installations have been electrically equipped, car-dumpers are built for either steam or electric operation. The stationary turnover car-dumper usually is employed in connection with transfer cars or other conveying devices. The moving car-dumper propels itself along the dock or edge of stock-yard, rendering unnecessary the use of transfer cars or conveyors. The stationary lifting car-dumpers are usually employed for discharging cars directly into boats, or into elevator bins.

Electric power is used exclusively for the operation of

the operating cycle in all types of car-dumpers the electrical equipment is required to handle high peak-loads and constantly varying power demands, as well as dynamic braking when lowering the car after its contents are discharged. Great delicacy of control is required, through wide speed variations, and absolute safety must be maintained against current failure.

Direct-current equipment possesses all the necessary requirements for such operation, the motor-torque characteristics being ideal and the control easily lends itself to the arrangement necessary to produce dynamic braking, slow-downs, cut-outs, and limit switches, which are essential to satisfactory car-dumper operation. The speeds of a car-dumper are usually regulated to produce a complete cycle in $1\frac{1}{2}$ to 2 minutes or about 30 to 35 cars per hour, and under certain favorable conditions this capacity is far exceeded for short intervals. A notable performance appears in the handling records of one of the large coal-piers on the

Atlantic coast. This pier is equipped with two W-S-M car-dumpers which, in one day, dumped 930 cars having an aggregate of 45,500 tons at an average rate of 1½ minutes per car.

THE PROBLEMS OF THE RAILROAD COMPANIES

Seth Mann, traffic manager of the San Francisco Chamber of Commerce, appeals to shippers to be patient with the railroad companies until they have had time to readjust their organization after more than two years of Government control. He says that the first year after the return of the railroads to private control will be one filled with difficulties and obstacles to be met by the private carriers. It may be fairly anticipated that for at least a year they may not be able to furnish a transportation service equal in efficiency to the Government service. The public should be prepared for this emergency, and the carriers should adopt a new attitude toward the public which will keep them informed of existing conditions. Failing in this, the public demand may swing back to public ownership. An efficient and competent transportation service must be furnished. On the whole, competition in service produced better service than the Railroad Administration has been able to give. It remains to be seen whether the private owners can excel the Government administration in the future. The shippers of freight are convinced that the dangers of public control far exceed any disadvantages attaching to lack of uniform or consolidated operation under private management. On the other hand, they look forward to the return of competition and the control of the various systems of railroads by the respective private organizations of expert railroad managers as an immediate solution of the transportation question. The re-establishment of effective transportation systems out of the welded system of the whole country is complicated at once with hundreds of problems never before met in the history of railroads. These problems cannot be solved in a day or a month, or perhaps in years. It is during this time that the public should be patient. Some of these problems requiring time for solution concern the insufficient car supply. There should develop a new kind of railroad publicity and a new attitude of officers and employees toward the public. The public should be kept informed of the difficulties of reorganization and of the progress made and the plans for the future.

COMMERCIAL PARAGRAPHS

Bulletin No. 110, issued by the Metric Metal Works of the American Meter Co., Erie, Pennsylvania, outlines the principle of the orifice-type of meter for gas, air, or steam, and describes the various manufactures of the company. Differential gauges are likewise discussed.

'Grinding Data, No. 2' has just been issued by the Hardinge Conical Mill Co. Detailed results of tests at the Nevada Consolidated concentrator at McGill, and at the plant of the Arizona Copper Co. are given. This pamphlet is the second of a series published to advertise the Hardinge mill and present to those interested new data regarding grinding problems.

The Drake Lock-Nut Co. is smoothing out the way for trade relations with the foreign buyer. Geo. F. Drake, vice-president and general manager of the company, has worked out a plan enabling him to quote c.i.f. to any large seaport in the world. A buyer in Johannesburg, Buenos Aires, or Singapore may now know exactly what Drake merchandise will cost him landed at his seaport.

H. R. Wahl & Co., engineers, 1218 First National Bank Bldg., Chicago, have recently published an attractive catalogue on the Wahl dewaterer. This catalogue goes into detail regarding the performance of this device and is fully illustrated. H. R. Wahl, the inventor, was for a number of years connected with lead-mining companies in south-eastern

Missouri and the Wahl dewatering device is the result of a great many years of experience in milling practice.

The Allen Cone Co., engineers of El Paso, Texas, has issued Bulletin No. 14, which describes the method of utilizing the Allen sand cone in closed circuit with a ball or tubemill. The principal advantages from the metallurgist's standpoint are the large capacity and the small floor-space required. Simplicity is another feature of the cone which merits consideration.

Ray T. Middleton has resigned as general sales-manager for the Standard Steel Castings Co. of Cleveland to become vice-president and director of sales and advertising for the Kelly Metals Co. of Chicago, Detroit, and Los Angeles. His headquarters will be at Chicago, where the Kelly Metals Co. will, at an early date, establish its principal production plant. The company will continue its present plants in Detroit and Los Angeles and later establish a third branch plant, at a point to be selected in the East.

The regular quarterly meeting of the gold-dredge operators of the California Mineral and Metal Producers' Association was held in San Francisco, March 15, the feature of the gathering being a visit of inspection to the Union Iron Works plant of the Bethlehem Shipbuilding Corporation. During this visit George Hurst acted as host, and also presided at the luncheon served the visitors at the plant. The dredge operators saw, among other things, thirty destroyers under construction. These vessels, each driven by four turbines, will develop 28,000 hp. and a speed of 36 knots per hour. The floating drydock, in which a 10,000-ton ship was cradled, was another point of interest. In conclusion Mr. Hurst showed his guests two electrically-welded pontoons for the No. 5 Marysville dredge. These pontoons were constructed without rivets. The next meeting of the dredge operators will take place at Natomas.

An insurance policy for the sum of \$500 will be given entirely without cost to every employee of the Westinghouse Electric & Manufacturing Co. who has been in the service of the company for a period of six months or more. In addition, the employees, after April 1, may increase the value of their policies to amounts varying from \$1000 to \$2000, depending upon their length of service and continuity of savings. All employees who have been in the company's service for six months or longer and who deposit a sum each pay-day in the Employees' Savings Fund, equal to 2% or more of their earnings, will not only receive 4½% interest compounded semi-annually on such deposits, but in addition will automatically have their insurance increased to amounts up to \$2000, depending on the length of time they have been with the company. After five years deposits may be withdrawn without affecting the value of an employee's insurance.

In keeping with its policy to render the most efficient service possible to present and prospective owners of motor trucks, the Garford Motor Truck Co. of Lima, Ohio, has established a new department, the duties of which will be to gather authoritative information on the operation of motor trucks and to aid present owners to obtain the lowest cost per ton-mile. This department will investigate the operation of Garford motor trucks in all parts of the country, obtaining data relative to the operating costs in actual service. In each case an exhaustive investigation will be made of every detail entering into the operation and maintenance of the trucks in use, including problems in loading and routing, methods of delivery, housing, repairing, and driving. Much study will be given to the kinds and quantities of loads hauled, the distribution area, the grades and the conditions of highways, the climatic conditions, the frequency of stops, the speeds which may be maintained in conformance with conditions and State and town laws, in fact every item which has any bearing upon truck operating and maintenance.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, APRIL 3, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	475

WHO'S HOOVER?	476
---------------------	-----

Requests for information concerning the former Food Administrator. What a mine superintendent wrote. Mr. Hoover's early work as a miner in the West. His start with Louis Janin. What he did in Western Australia and why he was able to do it so well. Blunders made by writers in the magazines. His standing in the profession at home and abroad.

REPORT OF THE INDUSTRIAL CONFERENCE.....	477
--	-----

Outline of the report as issued on March 20. The scheme proposed. Regional conferences and a National Industrial Board. How it is to work. Need for a healthy public opinion. Prevention of disputes is better than cure. Joint organization of managers and workmen. A democratic and an American scheme. What Mr. Hoover and Mr. Gompers think of it.

ARTICLES

MINING IN THE PHILIPPINES IN 1919

By C. M. Eye.....	479
-------------------	-----

Mining did not flourish during 1919. Gold production. Cost of supplies. Prospecting is at a standstill. Placer mining. Future outlook.

THE BUNKER HILL ENTERPRISE—VII

By T. A. Rickard.....	485
-----------------------	-----

Development of crushing and concentrating practice. The first mill. The old South plant. Flow-sheet. The scheme of treatment in No. 1 West mill. Grading system for re-dressing jig concentrate. Influence of sizing on jig operations. Bunker Hill and Callow screens. Other equip-

ment. No. 2 West mill started on April 17, 1912. Some features of the practice in this plant.

HERBERT HOOVER: A SKETCH

By T. A. Rickard.....	494
-----------------------	-----

His parentage. A leader and organizer at college. First job at Grass Valley, California. Engineer for Louis Janin. Sent to Western Australia. Chief engineer for Chinese Imperial Bureau of Mines at the age of 24. Partner in Bewick, Moreing & Co. Director of sundry large corporations. His literary work. 'De Re Metallica'. Assisted stranded Americans in 1914. The Commission for Relief in Belgium. U. S. Food Administrator. The American Relief Commission. The Industrial Conference. "The most useful man in the world today."

THE CONTRACT WAGE SYSTEM FOR MINERS

By A. K. Knickerbocker.....	497
-----------------------------	-----

Wage-payment on Minnesota iron-ranges. Defects of so-called 'contract' system. Human nature problem. What happens under present methods. Suggested alterations for improvement. The difficulties to be overcome. Disadvantages of the proposed system. Summary of the advantages to be derived.

NOTES

COAL PRODUCTION OF INDIA.....	496
-------------------------------	-----

DEPARTMENTS

REVIEW OF MINING	501
THE MINING SUMMARY	507
PERSONAL	508
THE METAL MARKET	509
EASTERN METAL MARKET	510
COMPANY REPORTS	511
INDUSTRIAL PROGRESS	513

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.

A Modern Laboratory Mill

COMplete laboratory tests on properly designed apparatus enable you to determine the method of treatment best adapted to your ore *before* building your mill—and help you regulate every step of the process for highest efficiency.

The cost is significant as compared with a mill run—or an

investment in an unsuccessful milling plant. Just look over these MASSCO suggestions. MASSCO Laboratory Milling Equipment minimizes the possibility of failure, insures against loss of recoverable values, and saves the time and cost of large scale mill tests. Equip your laboratory with MASSCO ore testing specialties.

The Samson Crusher

A simple and durable laboratory rock breaker, easily cleaned—and of unusually ample capacity.

The McCool Pulverizer

This machine for crushing and grinding the ore to any desired degree of fineness is a favorite; it can be depended upon for long service.

No. 13 Laboratory Size Wilfley

A regular Wilfley Table complete in every detail—two interchangeable decks, enclosed head-motion, and tilting device. It's a miniature of our mill table at a low cost.

Ruth Flotation Machine

An ideal outfit for determining the flotative properties of any ore, and the effect of various oils and reagents. The pulp, thoroughly mixed with air is drawn down the hollow impeller shaft, and here it is forced in a steady stream toward the froth discharge lip—a complete laboratory size Ruth Machine.

Massco Clay Goods

Muffles, Crucibles, Scorifiers and Roasting Dishes made from the famous Colorado fire clays by experienced workmen—the standard of assay service.

WRITE FOR OUR BULLETIN—MASSCO EQUIPMENT
INCLUDES EVERY LABORATORY REQUIREMENT

The Mine and Smelter Supply Company

A Service Station Within Reach of You

Denver

Salt Lake City

El Paso

New York Office: 42 Broadway





T. A. RICKARD. . . . Editor

SHADE of metalliferous Murphy! The following description of a queer specimen of copper ore has been sent to us from Salt Lake City: "The original wood of the tree branch has been replaced bit by bit with copper—a form of replacement which is technically known among geologists as a 'pseudo-murph.' " Begorrah, an' phat duz yez t'ink av thot!

SPEAKING of 'lives' of Mr. Hoover, of which several have been, or are being, printed in the current magazines, we recommend our readers to get copies of the 'Sunset Magazine' published in San Francisco. In the March issue and in succeeding monthly issues they will find an account of Mr. Hoover's life and career by Rose Wilder Lane and Charles K. Field. Mr. Field is the editor of the 'Sunset' and was a classmate of Mr. Hoover at Stanford University. He and Miss Lane are writing what promises to be the most accurate and the most interesting description of Mr. Hoover and his work.

AMONG the items of news that may be considered important if true is the announcement, by the American Central Committee for Russian Relief, in New York, that "two valuable goldfields have been discovered in the Urals". It is stated that one of these lies 30 miles north of Ekaterinburg. The position of the other one is left to be placed in accord with the average man's meagre knowledge of Russian geography; so we shall suggest Ufa or Orenburg as points of departure. We are told, by the same committee: "Engineers have reported that if machinery were available these fields would make it possible to increase Russia's gold output by 60% within two years". As to that, we would like to know what the Russian output is; conceivably it may have so diminished, thanks to bolshevism, that an increase of 60% would not be beyond the capacity of one ordinary mine. The Ural region has been relatively unimportant as a source of gold during the last decade, so that any genuine revival of activity would be welcomed. However, relief for Russia is not likely to come so much from the discovery of gold as from the re-discovery of sanity as a guide in political affairs.

AT the end of 1919 the visible supply of gold in the world amounted to \$9,080,000,000, of which the United States held \$4,454,650,000, Great Britain \$1,113,065,870, France \$1,115,585,000, and Spain \$484,475,000,

the remainder being distributed among the smaller nations. The world's total production of gold up to 1919 is estimated at \$16,136,500,000, which leaves about six billion dollars unaccounted. It is believed that a quarter of this has disappeared entirely and that most of the other three quarters has gone into industry and the arts. Since the War the ratio of paper currency to gold has increased enormously. In 1913 the proportion of gold in the United States to other money and checkable deposits stood at 18%; in 1919 it fell to 11%. Thus the expansion of credit showed an increase proportionately greater than that of the gold base. Now that the flow of gold into this country has been checked, the excess of paper credits is being felt, with an inevitable rise in the prices of commodities. The volume of credit has expanded until the gold basis is becoming inadequate; the only remedy is the production of staples and other essentials of life.

TAX-PAYERS generally will have read with keen interest the recent publication of statistics concerning the growth of bureaucracy at Washington. During the War there was some excuse for it; now there is none. In April 1917 there were 37,908 civil employees in the service of the Government in the District of Columbia; at the date of the Armistice the number had increased to 117,454; today there are 100,120 departmental employees still at Washington. The worst exhibit is made by the Treasury department, which had 8285 employees on the eve of the War, and now has 38,140, which is actually an increase of 8798 since November 11, 1918. Several hundred acres of temporary buildings continue to be occupied by an army of workers, a large proportion of whom, says the chairman of the House Appropriations Committee, have little, if anything to do. Taking the country at large, a similar condition of extravagance appears to prevail. Before the War the Government had 500,000 civil employees on its payroll; today it has 726,369. It is time a large part of them were released for productive labor. A billion dollars can be saved, it is estimated, by doing so. It ought to be saved. We suggest the propriety of making a diminution in the number of Federal employees before the election.

DISCOVERY as a pre-requisite to the valid location of a mining claim has been emphasized in a recent decision of the U. S. Supreme Court, in the case of Cole v. Ralph. This case dealt with a dispute at Copper

Canyon, near Battle mountain, Nevada; it came before the Supreme Court on a writ of certiorari, the Court of Appeals having previously reversed the lower court. The Supreme Court holds that location confers no right in the absence of discovery, both being essential to a valid claim. Section 2332 of the U. S. Revised Statutes provides that possession and work on a claim for the statutory period of limitations is the equivalent, for patent application purposes, of a location regularly initiated, but does not excuse the necessity of a valid discovery. Nor does performance of assessment work take the place of discovery; if occupancy by the explorer is relaxed or is merely incidental to something other than a diligent search for mineral, and another enters peaceably, and not fraudulently or clandestinely, and makes a mineral discovery and location, the location so made is valid. A location based upon discovery gives an exclusive right of possession, and, so long as it is kept alive by performance of required annual assessment work, prevents any adverse location. To sustain a lode location the discovery must be of a vein or lode of rock in place bearing valuable mineral, and to sustain a placer location it must be of some other form of valuable mineral deposit, such as scattered particles of gold in the softer covering of the earth. Thus do the learned justices try to reconcile legislative dicta with geologic conditions.

AT the recent annual meeting of the Exploration Company, in London, Mr. R. T. Bayliss made some interesting remarks on the state of affairs in Mexico. He said that while at the moment conditions could not be said to be better than they were a year ago, he believed that they were going to improve. "There is an indication," said Mr. Bayliss, "of a desire for peaceful reconstruction from within, and a determination that order and good government must prevail in Mexico from without—that is to say, on the part of the people of the United States." However, he did not expect that much, if anything, would be done by the administration at Washington until after the inauguration of the new President next March. There was no suggestion that any departure from the policy of watchful waiting would involve armed intervention on the part of the United States, for that, said Mr. Bayliss, "would be the greatest calamity that could overtake peaceful alien traders like ourselves". With this expression of opinion we agree, as our readers are aware. War would stop all foreign mining operations in Mexico for several years, and, what is much more important, it would involve the United States in a territorial expansion that would be highly injurious, for many reasons, more particularly the possibly necessary assimilation of a large alien element at a time when this country is suffering from political dyspepsia. Mr. Bayliss suggested, again, the creation of an international commission, co-operating with the United States. It should not be beyond the capacity of diplomacy to institute good government and order in the conduct of Mexican affairs "and so to place it in the position of prosperity to which it is entitled, by its geographical position,

its climate, and its abundant resources". This is more than a pious wish; we feel sure that a man and an engineer of such proved sagacity as Mr. Bayliss can do something toward hastening the consummation of hopes so long deferred.

Who's Hoover?

At the present time, naturally, there is a lively curiosity concerning Mr. Hoover. We received a letter from the superintendent of a mine asking us to publish "a short biographical sketch of Herbert Hoover". Our correspondent explained that he was being asked daily "Who is Hoover?" He himself knew enough about the man of the hour to be able to meet the local demand with a few facts, but his fund of information was inadequate, so he tells us. We quote from his letter: "They [some of the mining community] went to town Sunday last. Monday morning I was greeted at the mess-house with 'Say, ain't it hell about Hoover?' 'What's hell?' I asked. 'Why he's an Englishman and he can't run for President!' 'Who is the liar that told you that', I asked, and hustled back to the office for the 'M. & S. P.' of the 7th last, and read 'The Hoover Boom' to them while they ate their hot cakes, and they went up the hill much relieved." We give this verbatim. He refers to our issue of February 7. In his letter to us he asks for particulars of Mr. Hoover's mining activities, especially in his earlier days. We are glad to comply with this request, which we have reason to know voices the desire of hundreds of our readers. So we publish a biographic sketch on another page. Mr. Hoover worked as a miner in this State, but soon ceased thumping a drill or swinging a shovel, because he was ambitious and intelligent, and therefore wanted to engage in the engineering work about a mine, for which his education had been a preparation, however inadequate that education or any other college training may be. He went to Louis Janin for employment and was engaged as an assistant. A story in the magazines says that he was asked by Mr. Janin to do typewriting and that he agreed to do so, buying a machine and teaching himself to use it within two or three days. This is apocryphal. The story is foreign to Mr. Hoover's character; he never was a bluffer nor does he deal in such cheap stuff. While with Mr. Janin he examined mines in several western States, including Colorado, New Mexico, and Nevada. He did so well that his chief recommended him for an attractive appointment in Western Australia. Mr. Hoover went abroad for the same reason as many other leaders of our profession, namely, because he was so competent that his services were in demand. The present writer met him in Western Australia in 1897. He was then only 23 and looked even younger, but he was a man among men, intelligent, keen, quiet, and resourceful. That part of Australia was enjoying a boom and the hotels were cluttered with half-baked engineers and fakers of various kinds. It was a relief to meet the young engineer from California and to discover that he could 'deliver the goods', that he knew what he was about, and that he could be trusted to do it up to the hilt. The

articles in the magazines, notably those in 'Everybody's', the 'World's Work', and the 'Review of Reviews', are written by men unfamiliar with mining, so they contain a lot of nonsense. They say he "located" one of the richest mines in Western Australia, that he introduced a wonderful "new process" for the extraction of gold, that "the ore occurred in the rock in a manner different from that in any other known goldfield", and so forth. This is rubbish. It was because the conditions resembled those with which he had become familiar during his short but intensive experience in our West that he was able to direct operations effectively and to appraise mines successfully in Western Australia. He had learned, under Janin, how to sample mines and how to weigh the factors that determine the present value of a mine. He knew more about the essential elements in the daily problems presented to the mining fraternity at Cue, Coolgardie, and Menzies than men twice his age. He was intellectually honest then, as now. He knew how to select assistants then, as now. He was a hard worker, wasting no time on frivolities, but going straight to the mark. His success—given health and opportunity—was certain. It proved phenomenal. Before he was thirty he was in charge of enormous operations and receiving an immense salary, which he earned—every bit of it. In course of time he became a partner in the English firm with which he was first connected in Western Australia. He went to London and after a few years opened an office on his own account.

He was one of several score Americans connected with mining operations controlled from London; for London was still the centre of mining in its world-wide aspect. Other American mining engineers went to South Africa and made fortunes. Some of them lived at headquarters with offices in the same building as Mr. Hoover. During the two decades between 1895 and 1915 the American mining engineer as a type came into his own; he had proved his ability and was engaged by European financiers and directors, by the British, the French, and the Germans. It is a noteworthy fact, however, that not one of them changed his citizenship by naturalization. None of them even thought of doing so; nor, it is fair to add, were they ever asked to do so. They lived for ten or twenty years away from home, but they always expected to return to God's country. As for Mr. Hoover, he was "as American as baseball or corn on the cob". Mr. Will Irwin said that and it was well said. Both of us saw Mr. Hoover at work in London and know how bluntly, uncompromisingly, outspokenly American he was at all times. To suggest that he adapted himself to his British environment or abated any of his Americanism must amuse the Europeans with whom he had to deal in later years. Despite a lack of suavity and of those little amenities that are prized in Pallmall or the Faubourg, he won the esteem of the men with whom he was engaged in mining operations. He won their esteem and their confidence. This was proved strikingly only a few months before Germany started the War, when a group of companies became involved in a scandal owing to the

misdirection of affairs by the chairman, a man belonging to an aristocratic and distinguished family. His bankruptcy and the exposure of gross mismanagement created a shock in the city of London. His co-directors were in serious difficulties and became anxious to regain public confidence by selecting a new chairman that would restore the morale of their enterprises, one a gold mine in Colorado, another a silver mine in Mexico, and a third a copper mine in the Transvaal. They selected Mr. Hoover, who was not a director of any of these companies and held no shares in any of them. It was a striking tribute to his public reputation as a technician, financier, and administrator. Since then he has done so many bigger things that this episode has become of minor importance, but to the profession it will have a permanent value because it established his standing in mining affairs. Before the War, Mr. Hoover ranked among the first six mining engineers in the world and we could not with any confidence select more than three others out of the six. He was at the very top of his career as an administrator of mines at the time when, at the beginning of the War, his public and patriotic spirit drew him into larger work and vaster responsibilities. He is only 45 now. He has refused decorations by the score, but he did accept the title of the First Citizen of Belgium. When King Albert was in San Francisco and was being entertained at a public luncheon, the name of Hoover was mentioned by the chairman, whereupon the King stood up, in recognition of the fact that Mr. Hoover was the First Citizen of Belgium. Shall his own countrymen do less? Let us elect him First Citizen of the United States.

Report of the Industrial Conference

In our issue of January 10 we gave an outline of the preliminary recommendations of the Industrial Conference convened by the President at Washington on December 1, 1919. On March 20 this Conference issued its final report, and it is remarkable how little attention the daily press has given to it, although it is an earnest and intelligent effort, by a number of particularly competent men, to evolve a scheme for diminishing the troubles arising from the conflict of interests in American industry. The conferees, in their report, start by affirming that the place to prevent misunderstanding is where it begins, namely, in the plant itself, and therefore the first step should be the joint organization of employers and employees with a view to making a collective agreement by mutual understanding and concession. In default of such agreement, the Conference proposes a system of settlement under governmental encouragement. The scheme, in the main, follows the outline made known on December 29. It consists of a plan, nation-wide in scope, the chief feature of which is the establishment of regional adjustment conferences co-ordinated with a National Industrial Board at Washington. This Board is to consist of nine men appointed by the President. The regional conferences are to consist of two representatives of each of the disputants and four others

in the same industry to be chosen by them, with a presiding officer nominated by the Government, this chairman being a trained official able to play the part of a conciliator. In case of failure to agree, the dispute goes to the National Industrial Board, unless the parties to the controversy agree in preferring to submit the matter to an umpire to be selected by them. Voluntary submission of a dispute includes an agreement by both parties not to interfere with production pending adjustment. If either party, or both, refuses to submit the dispute to this process of adjustment, the regional chairman is empowered to call into conference with him two employers and two employees detached from the dispute but engaged in the same industry. The conference so organized will then make an inquiry and publish its findings, for the purpose of guiding public opinion. The whole idea, therefore, is to encourage a reasoned discussion of grievances, to adjust them if possible, and, if not, then to place the facts before the country so that the weight of public opinion may make itself felt. Here the question of the character of the local press obtrudes; the creation of a healthy public opinion is vital to the operation of any such scheme, as it is to the enforcement of all salutary legislation; the influence of a debauched press, like that of San Francisco, is lamentable because it does not place the facts before the public or else willfully distorts them so as to render intelligent opinion impracticable. For instance, the important report that we are discussing has not appeared in any of the three local papers that we have to read daily. The plan, as outlined, it will be seen, imposes no penalties except public condemnation, nor does it impose compulsory arbitration; it does not deny the right to strike, nor does it submit to arbitration the rival policies of the 'closed' and 'open shop'. Its main purpose is to facilitate settlement by discussion and the enlistment of public opinion in enforcing a settlement once the points at issue have been made clear. Prevention of disputes is worth more than cure. One of the chief causes of misunderstanding is the loss of personal contact between employers and employees due to the growth of industrial operations. In order to cultivate the right, that is the humane, relationship between capital and labor, between managers and workmen, it is necessary to organize that relationship deliberately, within the plant, thereby enlarging the unity of interest and diminishing the area of conflict. Experience has shown that where the joint organization of management and workmen is undertaken with sincerity and goodwill, it has succeeded in establishing friendly relations. It has worked well under union agreements, in non-union plants, and in those in which union and non-union men work side by side. Of course, the chief difficulty will be the selection of representatives by the employees without fear or favor from the employer. The selection should be made by secret ballot and there must be no discrimination by the management against the members of the shop committee. There will come the real test of sincerity on the part of the management. As to collective bargaining, the Con-

ference "sees in a frank acceptance of this principle the most helpful approach to industrial peace", but any successful, that is; fair, application of the principle must rest upon good faith on both sides. The Conference says: "It is fundamental that the basic wages of all employees should be adequate to maintain the employee and his family in reasonable comfort and with adequate opportunity for the education of his children. When the wages of any group fall below this standard for any length of time the situation becomes dangerous to the well-being of the State." As to profit-sharing, the Conference says that while it has "promise in some directions, it cannot by itself be considered to be of far-reaching effect". In conclusion, the report states that the suggested reforms are urged "not with any feeling of panic, but with the belief that they will not only contribute largely toward the elimination of the causes of industrial strife, but that they will make for the introduction in American industry of those democratic principles which constitute the most precious heritage of the American citizen". To that we subscribe most sincerely; the report shows a spirit that is humane, democratic, American; it does honor to the members of the Conference and more particularly to its acting chairman, Mr. Hoover, whose ideas, and even phrasing, can be detected throughout the report. The recommendations were unanimous, says Mr. Hoover. He states also that collective bargaining was adopted by the Conference "as a policy, but not as a principle". On page 508 we quote further remarks made by him on the subject. Mr. Samuel Gompers, we regret to note, strikes a dissentient note; he asserts that the machinery devised by the Conference is no improvement upon the means already available and "worked out through long experience by organized workers and employers". Indeed, he is of the opinion that the machinery of adjustment already existing is superior to that suggested by the Conference; he objects more particularly to the settlement of disputes shop by shop, emphasizing the point that the independent shop unit is "a menace to the workers, for the reason that it organizes them away from each other and puts them in a position where shop may be played against shop." He concludes with a defiant note: "American labor understands, perhaps more fully than do American statesmen, the needs of the world in this hour, and is exerting every effort to see that those needs are met with intelligence and with promptness." What the captains of industry think of the report, we do not know; but it is more than probable that some of them will not like it. We do believe, however, that the public generally will accept the proposals of the Conference as just, practicable, and therefore wise. The aim obviously is to prevent if possible the extension of trouble from any one plant to other plants, leading thereby first to a sympathetic strike in an industry, and then to a general strike throughout the country, as has been threatened more than once. What a general strike means we have seen lately in Germany: it means revolution, nothing less; it means defiance of the Government; it is the suicide of democracy.

Mining in the Philippines in 1919

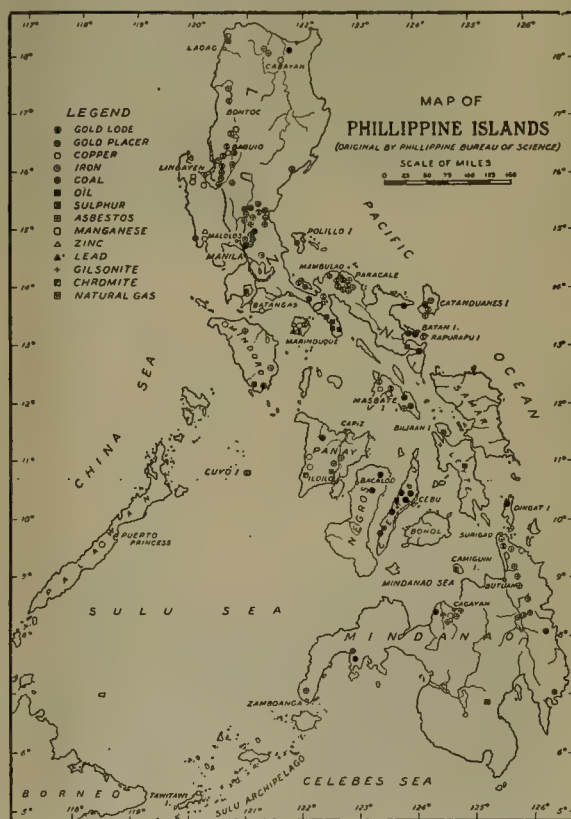
By C. M. EYE.

In common with most localities, the year was not a favorable one for mining in the Islands, owing to the greatly increased costs, unsettled industrial conditions, lack of adequate transportation facilities, and uncertainty as to the future. In gold mining, which leads other branches, there was a marked falling off in production, owing principally to the closing down of most of the dredges (operating for the most part in the Paracale district), in some cases due to actual exhaustion of available areas, and in others to the advance in costs beyond the point where operation at a profit was still possible. No definite figures on the total gold production for the year are available at this time, and it will be more difficult than usual to get full returns, as the substantial premium on gold that prevailed locally resulted in many of the smaller producers selling directly to dealers. As there is a bullion tax (of 1½%) in force, the Bureau of Internal Revenue should have figures covering the regular production pretty accurately.

The three principal gold mines of the Islands, namely, the Colorado and Syndicate of the Aroroy district, Masbate island, and the Benguet Consolidated of the Benguet district, island of Luzon, all maintained a steady output during the year, the two former at about the same rate of production as heretofore, and the latter at an increased rate. At all three larger tonnages were treated than formerly, but at the first two the grade of ore was lower. All three were able to operate at a profit, however, in spite of increased costs, the Benguet Consolidated making the best showing, thanks to a mill-feed of \$20 per ton. The Colorado paid a 5% dividend in June (with a possibility of another in December), while the total dividends for the Consolidated will amount to at least 35% on the capitalization of half a million dollars. (Capitalization of the Colorado is the same.) As regards costs of operation, all three mines buy most of their supplies in the States, but the expense, owing to high first cost and high freight-rates, was much greater than heretofore. The Aroroy mines are favorably situated as regards local transportation, being near the sea, but they suffered most heavily from increased price of fuel-oil, on which they depend almost altogether for power. The Benguet Consolidated has an advantage in having its own hydro-electric power-plant, furnishing power for less than a cent per kilo-watt, but has to stand a charge of about \$20 per ton on freight from Manila to the mine. Labor cost did not show as stiff an advance as that for supplies, nor any such ratio of advance as in most mining districts. The price of rice advanced during the year, and as this is the staple food of the workmen, this increase affected local economics considerably. The Benguet Consolidated has always maintained a system of rationing its employees,

which minimizes any such effect, and has the result of securing more steady service than is otherwise possible.

As silver production is limited to that recovered in combination with gold in bullion, there cannot be said to be any silver-mining industry in the Islands. The same may be said of the mining of lead, zinc, and copper, in so far as any actual production is concerned. There is no local smelting industry, and if any base-metal ore was exported, the amount was negligible. During the years



immediately preceding 1919, some exports of manganese ore were made from a property on the west coast of northern Luzon, and some from other localities, to Japan, under the spur of war prices, but I am not aware of any having been made in 1919. The most notable development was the taking over of a large deposit of limonite ore at Mambulao, in south-eastern Luzon, by a Japanese company, and the start of regular operations of mining and shipping to Japan by a line of steamers owned by this company. This should develop into an important business, profitable to the Philippines, which are best adapted to production of raw ores, and to Japan, which is in need of them. This observation will apply to the possi-

ble production of raw ores from certain known deposits of the base metals in Mindoro and elsewhere, though these it may be found possible to ship to Pacific Coast smelters, in case return-freight rates become normal again. Since local conditions preclude local smelting, the hope lies in being able to produce ores of a grade suitable for export.

Prospecting has practically ceased, in the commonly accepted meaning of the term. No new districts are being opened up, and few extensions were made in known districts last year. While Filipino capitalists are fairly ready to invest in going concerns, they do not take to the business of discovering and developing prospects. The principal developments have been on properties already extensively explored, and taken over on bond. Notable among these is that of the Mancayan copper deposit in northern Luzon, by Philip Whitaker, financial representative of certain Catholic orders, the Acupan mines of the Benguet district, by A. S. Wheler, representing English interests, and the Demonstration mine, near Baguio, in Benguet, by a Chinese syndicate of Manila, represented by Victor Lednicke, formerly Chief of the Division of Mines of the Islands. On all of these properties, development is said to be proceeding satisfactorily, and I venture the opinion that there are a number of other known deposits in the Islands that fully warrant the expenditure of capital for judicious exploration, provided they can be bonded on reasonable terms and for a sufficiently long period (say, two years in most cases) but with a provision for continuous work. It is a notable fact that the producing mines mentioned in this article were proved with comparatively small expenditure prior to operation, and there is no doubt that, given sufficient time, a great deal can be done with a comparatively small capital, in this way, but the common mistake has been made to try to make a prospect pay its way by beginning small-scale operations before the mine has been sufficiently developed. If these precautions are observed, I am of the opinion that the Philippines offers a good field for those who are seeking new producers, especially of gold.

The outlook for placer mining does not appear to be as favorable, for the known deposits at river-mouths seem to be nearing exhaustion, and while there are reported extensive gravel deposits where certain gold-bearing streams debouch on the coastal plains, these are both difficult to check by testing, and will be more difficult to work by dredging than the deposits heretofore handled. Nor is the grade of these gravel deposits likely to be as high. However, they may warrant thorough investigation in some cases.

It is to be hoped that something will occur to stimulate the mining industry in the Islands beyond that of the already operating producers, or the business will soon show a further decline. Of the three regular gold producers, the Benguet Consolidated was the only one that showed a material increase of production over former years, and this was due mostly to the tonnage having been increased from about 60 tons per day at the beginning, to around 80 tons during the last months of the year. The produc-

tion, which was about \$30,000 per month at the beginning, was increased to over \$40,000, that for October being in excess of \$50,000. This mine has several years supply of ore blocked out, of the grade indicated, all above the drainage-level, and has no indications on this level of diminution either in grade or extent of the ore-bodies; so it has considerable possibilities for the future, but nothing has been proved below the water-level. A three-compartment vertical shaft is now being sunk; this should cut the lode at about 700 ft. An additional hydro-electric plant of 250 kw. capacity was completed in 1919, making this development possible. With regard to the future of the other two producers, I have no definite knowledge. The Syndicate mine has never been developed in depth, and is commonly reputed to have large reserves of rather low-grade ore, while it is generally conceded I believe, that the main orebody in the Colorado has been bottomed, and that the hope of a life beyond a few years lies in the possibility of finding and developing other bodies of pay-grade within the limits of the property. Be this as it may, there is sufficient ore in these mines to maintain production for some time to come, unless costs continue to climb to the point where profitable operation ceases.

THE iron mines of Norway are chiefly in the extreme northern part of the country, in the Sydvaranger district. Owing to the fact that there is no coal the ore is concentrated and exported for smelting in other countries, chiefly England. In normal times the Sydvaranger mines employ about 1500 men; the annual production of ore is about 400,000 tons. Because of the impossibility of getting tonnage at any suitable rate for ore shipments, although the company had large contracts for freight made in 1914, transport of ore was largely stopped during the last three years of the War and the ore accumulated at the mines. The works were gradually shut down, and at the close of 1918 only about 500 men were employed. The re-opening of these mines is expected as soon as tonnage can again be obtained at suitable rates.

VIRGINIA is the only great producer of soapstone in the world, shipping more than 15,000 tons in 1918. The production has, however, declined irregularly for the last 10 years. Soapstone is one of the rocks that are most widely useful to primitive peoples, who, on account of its softness, resistance to sudden changes of temperature, and slow radiation of heat, employ it chiefly as 'potstone'—that is, for making pots. We make a similar use of it in soapstone stoves, foot warmers, and disks for fireless cookers, although in this country it is used principally in laundry tubs, laboratory tables, hoods, and sinks.

THE PANAMA CANAL OFFICE reports that traffic through the Canal in 1919 exceeded that of any previous year; 2396 ships of 7,128,000 net tons, in addition to naval ships displacing 1,000,000 tons, passed through the waterway. Cargoes of merchant ships amounted to 7,711,000 tons.



RUINS OF THE FIRST MILL, ERECTED IN 1886. HAYSTACK PEAK IS SHOWN BY A WHITE CROSS



THE SULLIVAN MINE AND REED MILL IN 1891



THE MILL AND TRAMWAY IN 1901



THE SULLIVAN MINE AND THE FIRST MILL



THE BUNKER HILL MILL AT KELLOGG, IN 1896

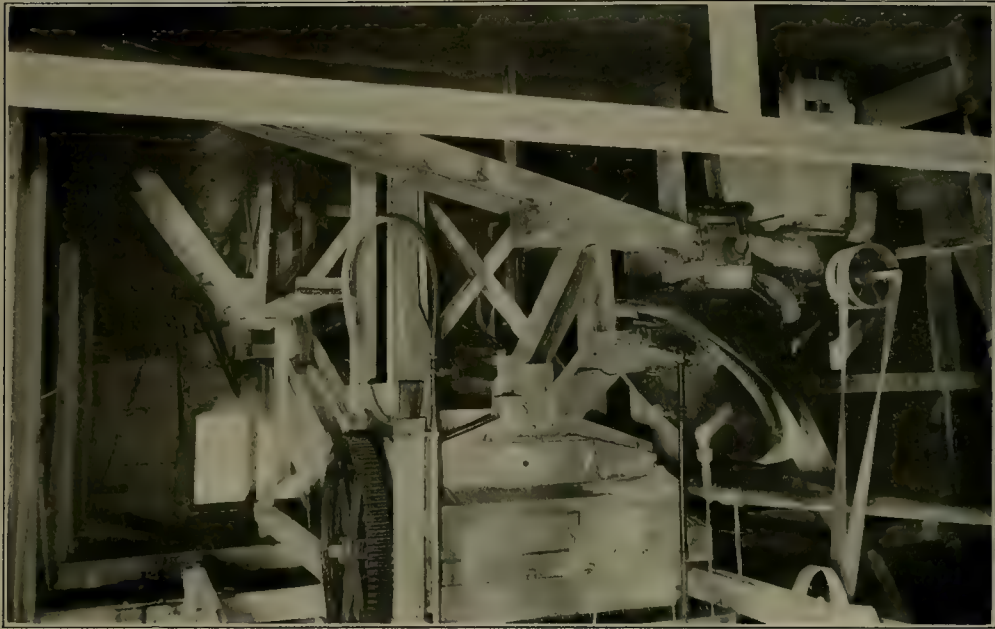


THE WEST MILL NO. 1 IN 1904

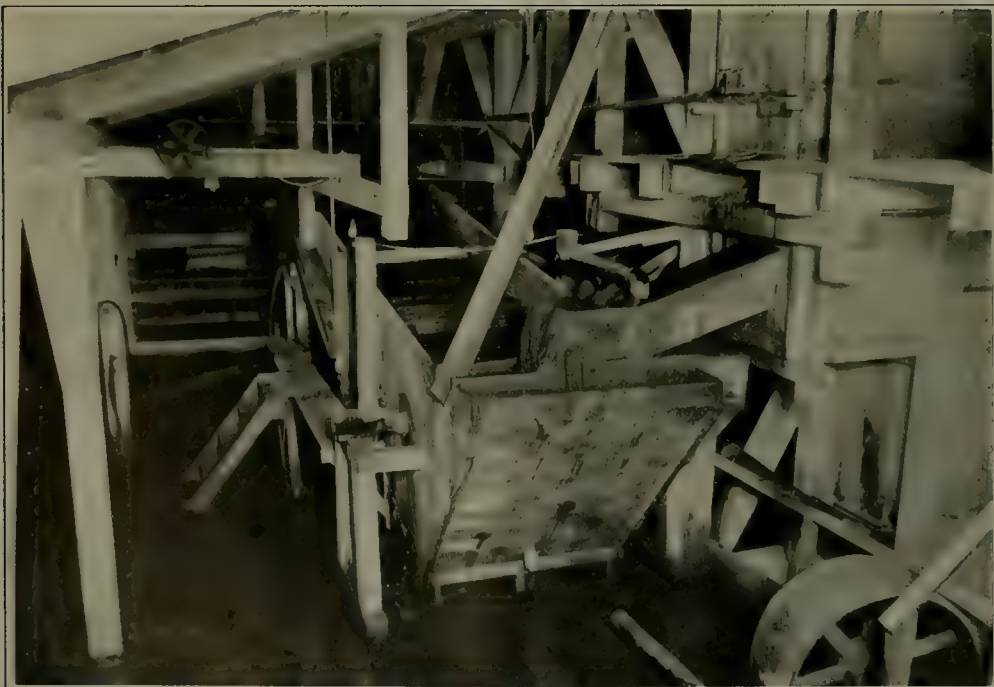


THE BUNKER HILL MILLS IN 1919

- | | | |
|-------------------------|------------------------|--------------------|
| 1. South Mill | 3. West Mill Ore-House | 5. West Mill No. 2 |
| 2. South Mill Ore-House | 4. West Mill No. 1 | 6. North Mill |



BUNKER HILL SCREEN FOR SEPARATING WOOD-PULP



THE ESPERANZA CLASSIFIER

The Bunker Hill Enterprise—VII

Development of Crushing and Concentrating Practice

By T. A. RICKARD

The first mill was built in Milo gulch, near the portal of the Reed tunnel, in 1886. The scheme of treatment is outlined in Fig. 1.* It will be noted that the equipment included Harz jigs and Cornish buddles. The capacity of the mill was 100 tons per day, from which it produced 20 tons of concentrate, containing 65% lead and 28 oz. silver per ton. This product was hauled to the narrow-gauge railroad at Kellogg, which was then little more than a clearing in the dense forest that covered the valley. From there it was shipped to the smelter at East Helena, in Montana. Samples were sent from the smelter to the mine; the assays were made promptly at both ends, and the results returned by mail so as to cross in transit. It is curious to note that if the results did not differ by more than 2 oz. silver per ton and 2% lead, the difference was split and the settlement completed accordingly. Nowadays the margin for reasonable difference is reduced to half an ounce of silver and half of 1% of lead.

This first flow-sheet was elaborated in the next mill, which was built at the portal of the Kellogg adit in 1890. It was called the Old South plant and was supplied with ore by means of an aerial tramway that passed over the town of Wardner, as shown in one of the accompanying photographs. Fig. 2 gives the flow-sheet. The ore, after being crushed to 3-in. size at the mine, was delivered to a Bleichert tramway that discharged into a mill-bin holding 500 tons. When the Kellogg adit was completed in 1902, the present ore-crushing house was built and the use of the tramway was discontinued.

The sizing system consisted of a series of five trommels, made respectively of 36 mm., 18 mm., 10 mm., 7 mm., and 3 mm. round-hole screens. The successive products from these trommels passed to corresponding Harz jigs, each having compartments 19½ by 31½ inches. The undersize from the 3-mm. trommel went to four hydraulic classifiers. The first three spigots delivered to jigs of the same type as above-mentioned; the last two spigots delivered to two double-deck buddles of 16 ft. diameter. The overflow from the classifiers passed through a V-tank, 6 ft. deep and 90 ft. long, where it was thickened previous to treatment on twelve 4-ft. Frue vanners. The oversize from the 36-mm. trommel was crushed in rolls, 36 by 14 in. The middlings from the coarse jigs were ground in two pairs of rolls, one 30 by 14 in. and the

other 31 by 16 in., the product from these being delivered to a 16-in. bucket-elevator that returned it to the head of the trommel system. The middlings from the fine jigs were ground in two 5-ft. Huntington mills and delivered from them to a 14-in. bucket-elevator, which fed a 3-mm. screen, the oversize from which was returned to the Huntington mill, while the undersize went to the head of the hydraulic classifiers.

The concentrate produced by the jigs assayed 58% lead and 25 oz. silver, that from the buddles and vanners assayed 45% lead and 20 oz. silver, whereas the tailing from the jigs assayed 3% lead and 1.2 oz. silver; and the fine tailing, 4.3% lead and 2.2 oz. silver. The average assay of the various concentrates was 55% lead and 24 oz. silver, at a total cost of 35c. per ton of crude ore. The ratio of concentration was 5½:1. These figures represent a general average of results between 1890 and 1906.

Fiscal year ending May 31, 1894

	Tons	Assay	
		Lead %	Silver %
Mine-product	98,180	15.29	8.31
Shipping-ore	4,224	51.09	29.60
Hand-picked ore	2,330	45.60	23.68
Concentrate	17,179	56.12	27.56
Tailing	76,776	4.19	2.85

Fiscal year ending May 31, 1896

Mine-product	142,706	9.44	4.05
Shipping-ore	1,319	46.69	19.13
Hand-picked ore	1,009	42.62	20.40
Concentrate	16,921	55.93	22.32
Tailing	124,465	2.80	1.44

Fiscal year ending May 31, 1899

Mine-product	178,687	10.45	4.55
Shipping-ore	5,364	47.05	19.08
Mill-ore	173,323	9.31	4.10
Concentrate	21,406	57.94	23.32
Tailing	151,917	2.46	1.39

Fiscal year ending May 31, 1900

Mine-product	160,570	10.85	3.23
Shipping-ore	9,346	45.61	15.90
Mill-ore	151,224	10.15	4.76
Concentrate	21,540	57.07	23.84
Tailing	129,632	2.37	1.59

This Old South mill was destroyed by dynamite during the great strike of 1899, of which I shall give details in a later article. The plant was re-built on the same site and on much the same plan in 1900. See Fig. 3. When the Kellogg adit was completed in 1902 the flow-sheet was changed somewhat, as shown in Fig. 4, which gives the treatment as it was at the beginning of 1906. In 1906 Gelasio Caetani started to remodel the mill and intro-

*This is based upon the recollection of S. S. Fowler, who was assayer and surveyor for the company, in 1882, and of Edward Hearing, who has worked in the Bunker Hill mills from the very beginning. He is now foreman of the company's plant at Kellogg.

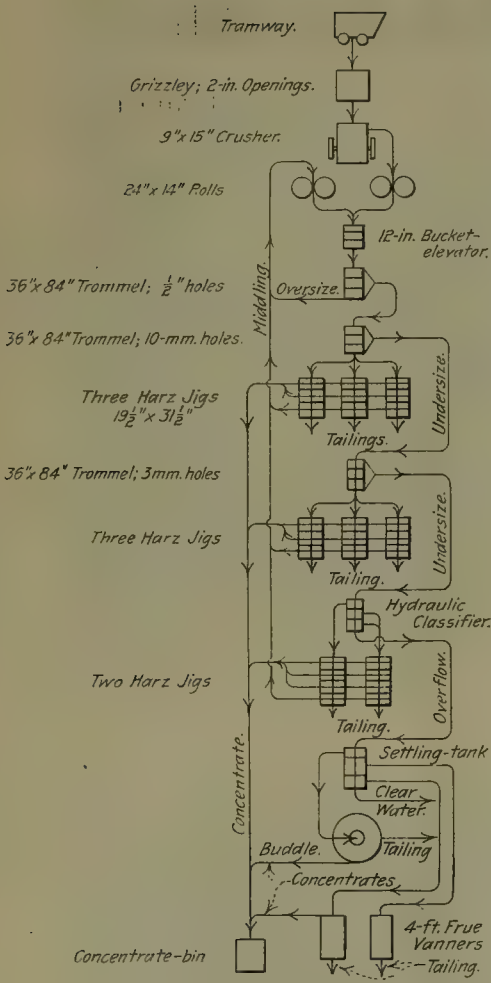


FIG. 1. FLOW-SHEET OF FIRST MILL, 1886

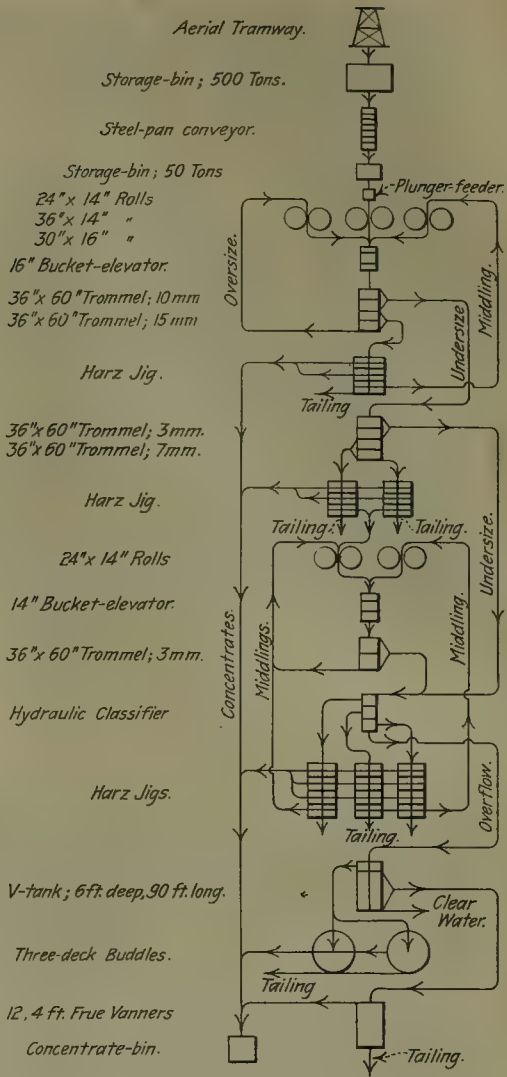


FIG. 2. FLOW-SHEET OF OLD SOUTH MILL, 1890

Record Showing Character of Operations

Date		Concentrate and		Assay		Contents		Cost of milling
From	To	Ore mined, tons	ore shipped, tons	Lead, %	Silver, oz.	Lead, tons	Silver, oz.	
May 1886	July 1887	26,855	7,266.96	69.00	29.33	5,014.20	213,140	\$1.75
Aug. 1887	May 1888	33,907	7,989.37	66.84	29.55	5,340.09	236,086	0.72
June 1888	" 1889	39,784	9,108.76	65.80	27.50	5,993.56	250,491	0.76
" 1889	" 1890	None						
" 1890	" 1891	17,092	1,612.85	65.40	27.86	1,054.27	449,340	0.50
" 1891	" 1892	52,114	9,638.01	61.30	27.69	5,908.10	266,876	0.43
" 1892	" 1893	105,287	17,876.77	58.45	27.53	10,448.97	492,147	0.57
" 1893	" 1894	99,657	20,324.41	55.67	28.18	11,315.00	572,921	0.52
" 1894	" 1895	71,084	11,647.30	55.10	24.23	6,418.13	282,210	0.41
" 1895	" 1896	142,977	18,058.88	55.26	22.10	9,980.01	398,944	0.33
" 1896	" 1897	171,359	23,039.67	54.94	23.91	13,157.72	541,095	0.28
" 1897	" 1898	187,244	29,421.89	57.05	22.19	16,789.93	652,863	0.25
" 1898	" 1899	178,568	26,515.34	55.99	22.54	14,845.63	596,722	0.29
" 1899	" 1900	160,036	31,045.71	53.41	21.33	16,583.38	662,457	0.35

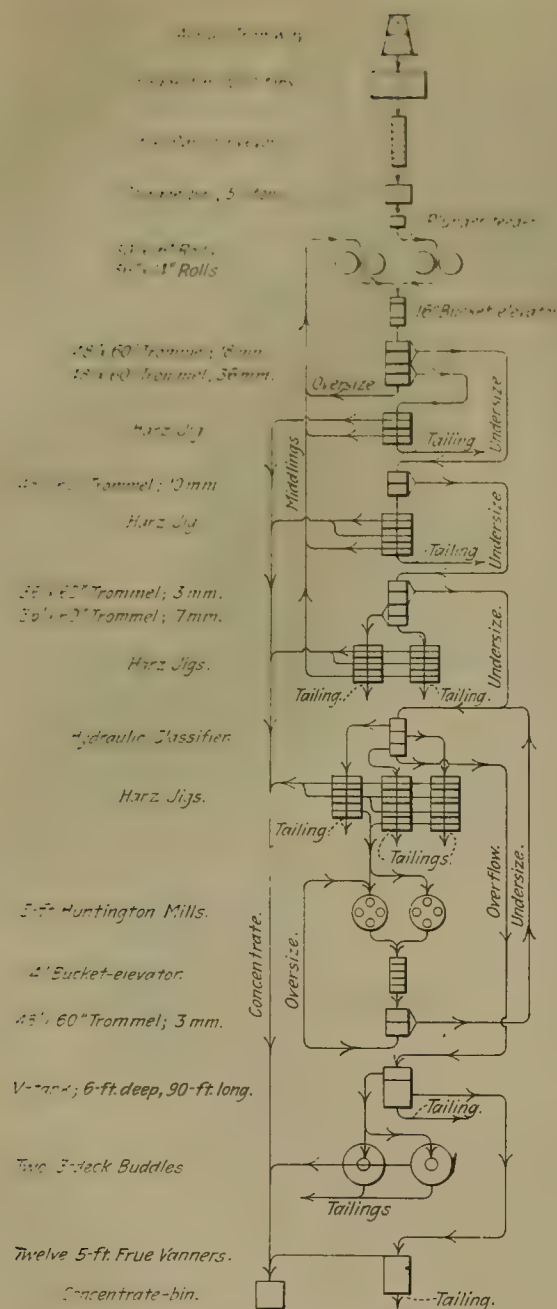


FIG. 3. FLOW-SHEET OF SOUTH MILL, 1900

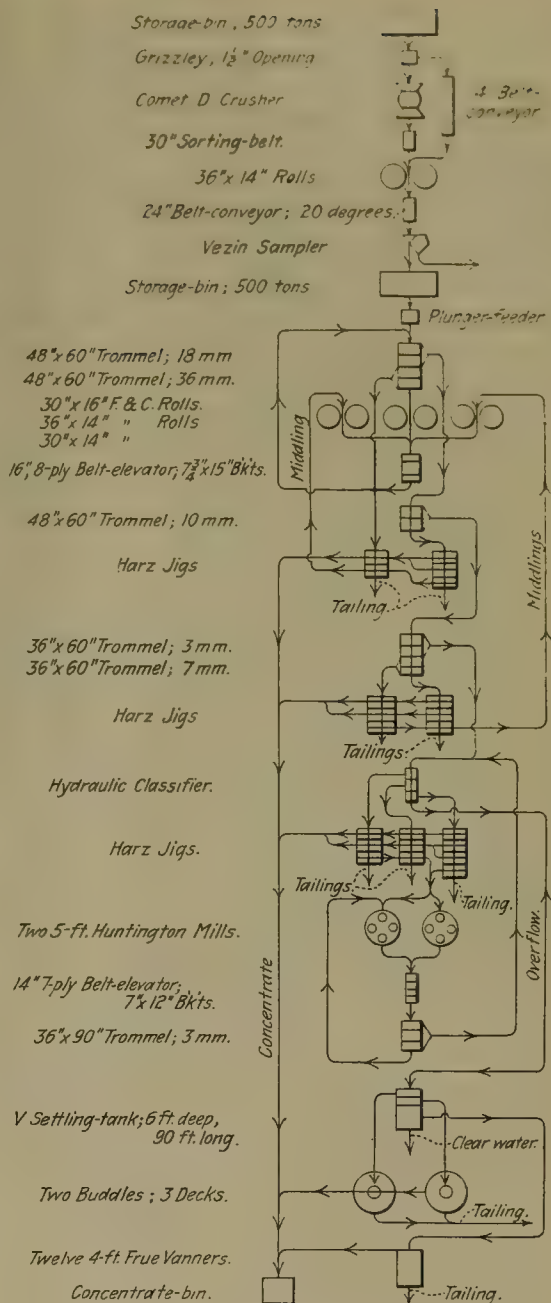
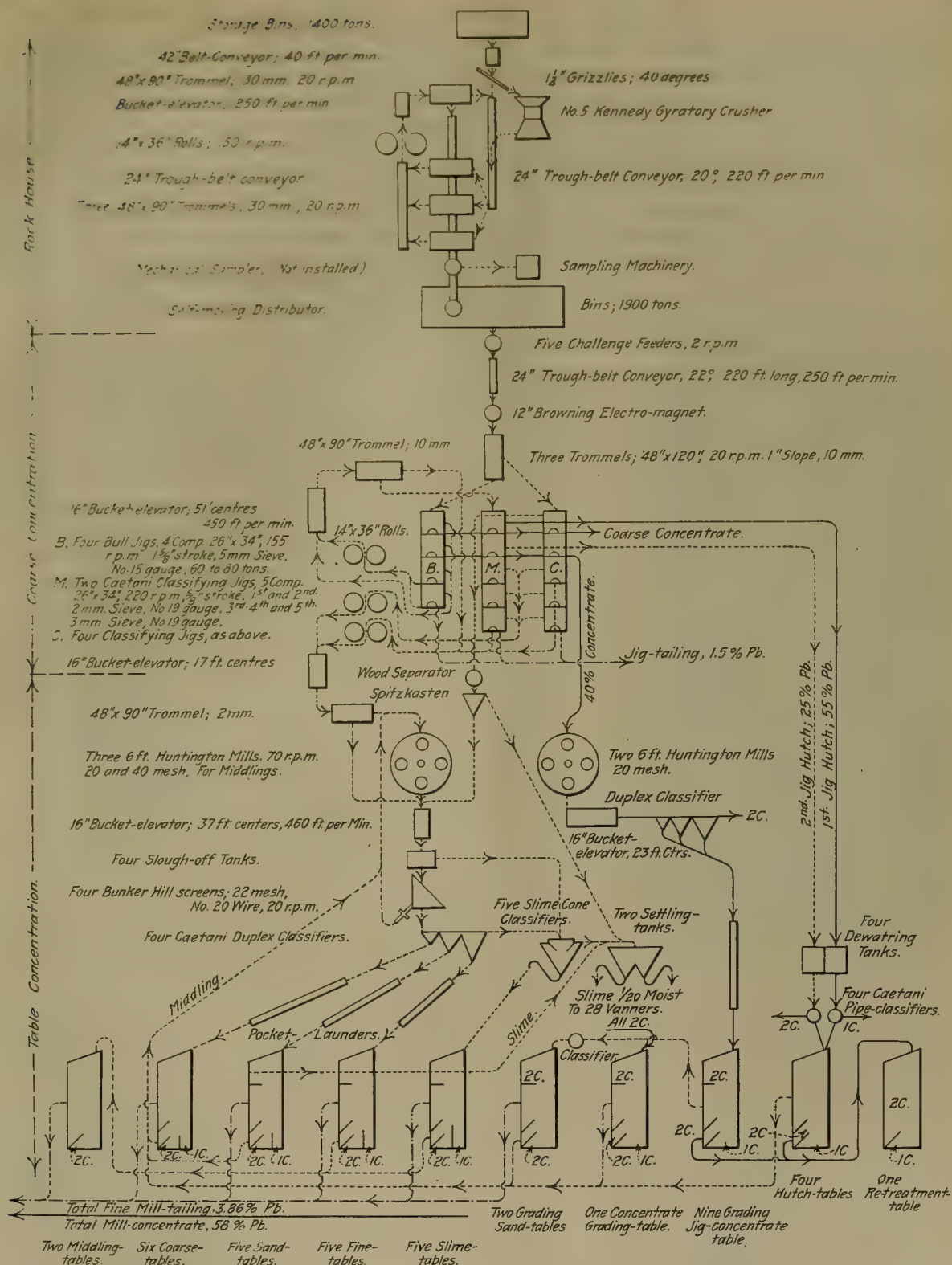


FIG. 4. FLOW-SHEET OF SOUTH MILL, 1906

duced the flow-sheet shown in Fig. 5. The principal change consisted in the addition of four No. 5 Wilfley tables and the discarding of the buddles. Two No. 5 Wilfleys supplanted the old buddles. The concentrate (40 tons per day, assaying 45% lead) from the coarse jigs was diverted to a 6-ft. Huntington mill and crushed to pass a 20-mesh screen before delivery to four No. 5 Wilfley tables. These made four products, as follows: (1) Slime, assaying 45% lead, which went to the shipping bin; (2) Middling, assaying 30%, which was pumped to

a Wilfley sand-table; (3) Another middling, assaying 50%, which went to two grading Wilfleys; (4) Concentrate, assaying 77%, constituting the first-class shipping product. The Wilfley sand-table made a 45% slime, a 10% middling that was returned to the general mill-circuit, a 40% middling that went to the second-class bin, and a 70% concentrate that went to the two grading Wilfleys for re-concentration. These two machines received the products mentioned, together with the concentrates from the vanners and Wilfleys of the main plant.



NOTE. THE TROUGH-BELT CONVEYOR SHOULD BE 20 IN., NOT 24 INCHES

The products from these grading Wilfleys were a 50% slime that went to the shipping-bin, a 20% middling that was returned to the general mill-circuit, and a 77% concentrate that went to the first-class bin, for shipment. The total production of this high-grade (77%) concentrate was 12 tons daily. The object of producing such a rich product was to escape the severe penalty to which any product poorer than 75% was subjected by the terms of the contract with the American Smelting & Refining Co., and also to reduce the freight and treatment charges per unit of metallic lead in the concentrate.

It is interesting to note that at this time (1906) the Callow screen and the impact screen were tested in the grading process. The experience gained by Mr. Caetani in this mill, thus modified, was a decisive factor in designing the next mill, called the West No. 1, which started to work on November 9, 1909. During the intervening three years, experiments were continued in the Old South mill with a view to obtaining data for improvements in the new mill. During this period (1907-1909) the old mill was so crowded with ore that the recovery suffered considerably. A plant, known as the North mill, had been erected in 1907 to re-treat the tailing-dump of the Old South mill; therefore, when the latter became over-crowded, it was decided to use the tailing-plant of the North mill as an annex. The flow-sheet of this last-mentioned plant is shown in Fig. 5. To this annex came the undersize from the 3-mm. middling trommel, the middlings from the various fine jigs, the middlings from the Wilfley grading system, and the tailing from the vanners. These several products went through an elevator-house near the South mill and from there to the North mill, where they were sized on Callow screens, the oversize being ground by 6-ft. Huntington mills, and classified by hydraulic classifiers and Callow cones, previous to being treated on 24 No. 5 Wilfley tables and 16 Frue vanners. This treatment yielded 17 tons daily of a 43% product and 168 tons of tailing assaying 4½% lead. Evidently a relatively rich tailing was going to waste, because it was profitable to treat more ore than the mill was capable normally of treating with the maximum metallurgical efficiency.

In January 1909 the South mill treated 27,400 tons of ore, assaying 14.2% lead and 5.1 oz. silver, the aggregate assay-value being \$15.48 per ton, with lead at 4.5 cents per pound and silver at 53c. per ounce.

Turning now to the flow-sheet (Fig. 6) of the No. 1 West mill, which represents the next advance in metallurgical practice, it will be noted that the run-of-mine ore was delivered to a storage-bin of 1400 tons capacity, and thence direct to a 42-in. flat-belt conveyor on a 10° incline to a grizzly having 1½-in. openings. The oversize from the grizzlies went to a No. 5 Kennedy gyratory crusher, which discharged, together with the undersize from the grizzlies, onto a 24-in. Jeffrey trough-belt conveyor, delivering to three sets of trommels (each 48 in. diam. and 90 in. long) having 30-mm. apertures. The undersize from these trommels passed over a 24-in. inclined trough-belt conveyor feeding a self-propelling

Jeffrey distributor, to a storage-bin holding 1700 tons.

The oversize from the trommels was carried by another 24-in. trough-belt conveyor to a set of Chalmers & Williams rolls (36 by 14 in.), delivering to a 16-in. bucket-elevator, which took it to a trommel (48 in. diam. and 90 in. long) having 30-mm. apertures. The undersize from this trommel joined the material that had passed through the preceding trommels, while the oversize joined the feed to these trommels, in a closed circuit.

From the bin the ore, now reduced to 30 mm. or 1½ in., was fed by five belt-driven Challenge feeders onto a 20-in. trough-belt conveyor, inclined at 22°, that passed under a 12-in. Browning electro-magnet and was then sampled by hand before going into three trommels (48 in. diam. by 120 in. long) having 10-mm. apertures. The oversize from these trommels was fed into four double jigs of the Harz type, each having four compartments, 34 by 26 inches. The undersize from the trommels went to four classifying jigs having five compartments of the same size as the preceding ones. These last jigs classified off, or separated, in the first compartment, a slime product of minus 20-mesh material. The first cup of the jigs yielded a coarse concentrate, assaying 53% and ready for shipment, while the second cup yielded a 40% concentrate, which was re-ground in two 6-ft. Huntington mills to pass 20-mesh before passing into the grading system, to be described later. The tailings from the jigs averaged 1.5%. The middlings from the coarse jigs passed through a set of Chalmers & Williams rolls (36 in. by 14 in.) delivering to a 16-in. bucket-elevator, which fed a trommel (48 in. diam. by 90 in. long) having 10-mm. apertures. The undersize from this trommel went to two classifying jigs, as before, while the oversize joined the middling from the fine jigs and was re-ground by two sets of rolls (36 by 14) delivering to a 16-in. bucket-elevator. This elevator discharged into a trommel (48 in. diam. by 90 in. long) having 2-mm. apertures. The oversize from the trommel was re-ground in three 6-ft. Huntington mills to minus 20-mesh, and then joined the undersize from the trommel, together with the spigot-discharge from a spitzkasten that treated the slime from the classifying jigs. There these mixed products were delivered by a 16-in. bucket-elevator to four spitzkasten, or 'slough-off tanks', the sand from which passed through four Bunker Hill screens of 22-mesh. The oversize from these screens was returned to the Huntington mills, while the undersize was prepared in four Caetani hydraulic classifiers for concentration upon six Card tables.

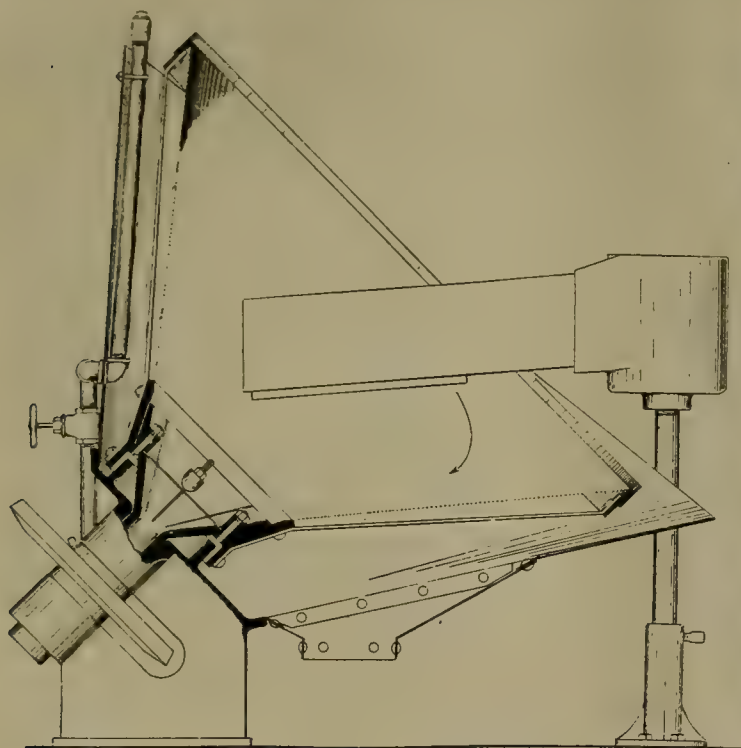
The overflow from the classifiers joined the overflow from the spitzkasten and was treated by a double-cone classifier. The sand from this classifier was discharged through a gooseneck to five Card tables, while the slime-overflow joined the overflow from the preceding spitzkasten treating the slime from the classifying jigs, this mixed overflow proceeding then to two V-shaped settling-tanks, which also received the backwater from 15 Card tables. The thickened discharge (1 part solid to 20 of water) from the settling-tanks was fed to twenty-eight 6-ft. Frue vanners.

The table-products consisted of a second-class concentrate that was passed over two Card middling-tables to a bin and a first-class concentrate that likewise went to a bin, ready for shipment, while the middling was returned to a Huntington mill, and a 3.86% tailing went to waste. The various concentrates produced in this mill averaged 58% lead and 21 oz. silver.

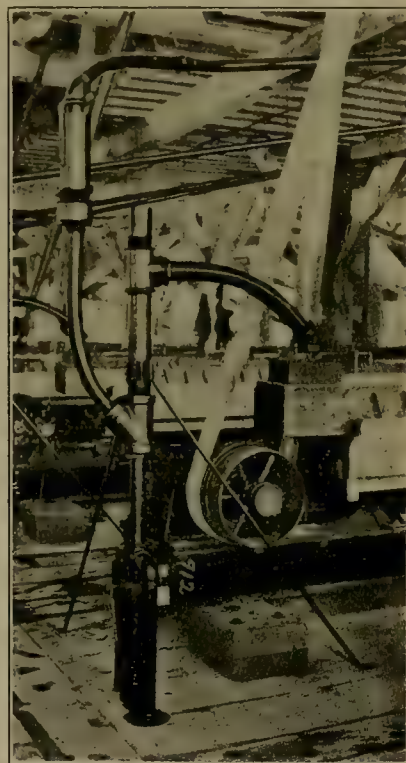
To the foregoing general description it is necessary to add a note concerning the grading system for re-dressing the jig-concentrate. This product was re-ground in two 6-ft. Huntington mills to pass 20-mesh and then delivered by a 16-in. bucket-elevator to a duplex Caetani classifier. The overflow from this classifier was a finished second-class concentrate; the spigot-discharge passing

In discussing the relation between sizing and jigging, Mr. Caetani made the following interesting remarks:

"It may be said that the first action of a jig is to throw to the surface the lighter particles that cannot settle through its bed against the pulsating current of water. The heavy mineral will settle almost immediately; the middling will do so after a time, but the fine material, once rejected, will pass from one compartment to the other without being able to find its way into one of the products. The Wilfley table has a similar action on the slime, which, unable to settle between the riffles, is washed off by the head-water. On almost any concentrating machine there is some material that evades the action of the machine and becomes 'outcast'. The existence and



THE BUNKER HILL SCREEN



PIPE-CLASSIFIER

through pocket-classifying launders to nine Card tables, arranged according to the system previously established in the South mill. About 300 tons per month of first-class concentrate was produced by this grading system.

In 1910 Mr. Caetani published a series of articles† describing the milling practice as developed at that time. He gave an analysis of the ore, to which I have added later figures, supplied by R. S. Handy, his successor.

Chemical	1910	1920	Mineralogical	1910	1920
Lead	13.58	10.3	Galena	15.70	11.89
Iron	22.85	18.0	Sphalerite	2.70	3.57
Zinc	1.80	2.4	Pyrite	3.15	1.57
Manganese	2.03	1.5	Siderite	44.30	35.80
Sulphur	3.80	3.6	Rhodochrosite	4.25	3.14
Lime		1.2	Calcite		3.30
Silica	23.90	40.0	Quartz	23.90	40.00
Oxygen		6.17	Silver	6 oz.	3.8 oz.
Carbonic acid	25.17	16.1			

character of this 'outcast' in the jig-tailings is illustrated in the following table, in which are compared equal-sized grains screened out of the tailings of five jigs of different sizes.

Size of grains	Size-limit of material fed to jigs				
	mm.	mm.	mm.	mm.	mm.
Through 3-mm., on 10-mesh...	10-7	7-3	3-1½	1½-½	Slime
Through 10-mesh, on 20-mesh...	3.00	2.60	1.36	0.94	1.20
Through 20-mesh, on 40-mesh...	3.13	2.90	1.80	1.29	1.50
	4.61	3.01	2.63	1.59	1.62

"These figures prove that the fine sand remains 'outcast', especially on the coarser jigs.

"The character of an 'outcast' material will vary with the type of machine. On the bull jigs, even small pieces of ore will be thrown over the tail-board; and on fine

† 'Milling of Lead-Silver Ore', in 'The Mining Magazine' for May, June, and July, 1910.

jigs, coarse pieces of ore will settle permanently on the sieve. Again, on a Wilfley table and on a vanner, oversize pieces of quartz will mingle with the concentrate." He concludes that the first effect of close sizing as applied to jigging, is the elimination of this 'outcast' material from the jigs, and that the limits between the sizes should be as large as will allow an easy separation, while keeping the bedding and the grade of the products in a stable condition. He proceeds: "This is especially true where the difference of specific gravity between minerals is small, as in lead-zinc ores, and where the ratio of concentration is high. Close sizing, however, is in many instances an accepted axiom, and a certain standard ratio of sizes is adopted without any theoretical or experimental guidance. As a consequence we find that sizing is often performed to an extent not justified by the character of the ore.

"These conditions are found in the South mill, where the screening is performed by five sets of trommels ranging in size from 36 to 3 mm. The trommels are overcrowded and their efficiency varies from 50 to 20%, that is, the products separated by the trommels contain 50 to 80% of undersize. Nevertheless, the jigs are doing remarkably clean work, because the Bunker Hill ore is well adapted for jigging.

"To determine these points an experimental plant of 100 tons daily capacity was erected, and it was found that with specially constructed jigs of the Harz type it is possible to handle all the mill-ore by dividing it into two products, a 30 to 10 mm. and a 10 mm. to zero feed. Until recently, it has been customary to jig coarser than 30 mm., but, since the lower levels of the mine have been opened, the galena is found to be more disseminated, and consequently the grade of the concentrate ranging in size from 30 to 36 mm. cannot be kept up to the grade commanding the best prices. The tailings from the coarsest jigs are remarkably clean; therefore, it is not the tailing loss, but the grade of the concentrate, that governs the upper size-limit of the ore to be jigged. The lower size-limit of the coarse-jig pulp is 10 mm. Sizing analyses show that the 10-mm. particles contained in the coarse-jig tailing are not higher grade than the same sized grains contained in the fine-jig tailing, nor are they appreciably higher grade than the total coarse-jig tailing itself; hence the 10-mm. particles are not 'outcast' when jigged together with the 30-mm. particles. The undersize of the 10-mm. trommel can be fed directly to the classifying jigs, which first separate the slime and fine sand, and then concentrate the deslimed portion of the pulp."

Speaking of the plungers in the jigs, he remarks:

"The length and speed of the plunger-stroke depend on the relative size of the plunger and jig-compartments, and on the size of the material treated. When jigging undersized material it is advisable to use a high speed and a short stroke. The fact that the smaller particles of ore occupy the interstitial spaces between the larger ones, gives to the water a greater lifting power on the coarse particles than it would have if acting on sized material. A long stroke on unsized pulp loosens the bed to

such an extent that the fine material is either sucked through the screen or thrown into disorder. [On the flow-sheet the stroke of the bull jigs is given as $1\frac{5}{8}$ in. and the speed 155 r.p.m., while for the middling jig the figures are $\frac{5}{8}$ in. and 220.] The plunger must have at least a $\frac{3}{8}$ -in. clearance all round, otherwise the suction through the sieve is too heavy. Plunger-valves have been tried, but without favorable results. The inconvenience of the air-blast caused by the movement of the plunger can be greatly reduced by boring two 2-in. holes through the partitions that divide one plunger-compartment from the other; the air will then circulate forth and back, and will not have the tendency to raise the plunger-lid."

In regard to the general principles underlying the methods of concentration, especially on the tables, Mr. Caetani remarks:

"1. In grinding, the free galena will concentrate exclusively in the fine stuff; therefore the oversize can be screened out and sent to the fine-grinding machines without first undergoing a process of concentration.

"2. No single machine should be required to do thoroughly clean work, but each operation of screening, classifying, or concentrating should be repeated by other machines on each single product of the first machine. Thus each machine acts as a roughing machine for the next following one, which in turn, treating material that is better prepared, performs a better class of work.

"3. Give each machine the greatest possible independence, by arranging that most of the pulps can be switched temporarily into other channels or onto other machines."

In regard to the Bunker Hill screen, he says that it is best adapted for screening from about 6-mesh to 80-mesh; for screening finer than 80-mesh, the Callow screen is preferable. Concerning the Card table, as compared with the Wilfley, he says that it has "a sharper return stroke with consequent greater progression and capacity, and increased simplicity in the method of suspending and adjusting the table. The Card also has the advantage of spreading the concentrate over a larger area, owing to the grooves, which, gradually becoming shallower, extend to the end of the table. . . The Card concentrator must have a fairly rich pulp to perform good work, that is, the ratio of concentrate to other products ought not to be less than 1:15, because this table, much more than the Wilfley, has to bed itself."

In closing his valuable paper, he says: "The chief aim was to design a mill of great mechanical simplicity and of high economical efficiency. Previous experience had taught that the main causes of troubles, delays, and repair-expenses are, in order of importance, trommels, bucket-elevators, transmissions, and liners. To prevent these troubles, the number of trommels has been reduced to a minimum, the wet elevators are made to elevate only comparatively fine material, the transmissions have been designed at the right angle, length, and direction, and placed so as to be free from grit and water, and special care has been taken to reduce the wear of the liners to a minimum. The mill is divided into three departments

mechanically independent, and the ore progresses from one department to the other, undergoing at each step a complete treatment, so that none of the products is ever returned through the channels and over the machines through which it has already passed. This prevents the idle circulation of products; they move rapidly through the course of treatment, with the result that the mill is very sensitive, any change in one part of the mill being immediately shown in other parts. This sensitiveness calls for more attention from those in charge, but prevents any defective operation remaining undetected and is, I believe, a most valuable feature. All the products of

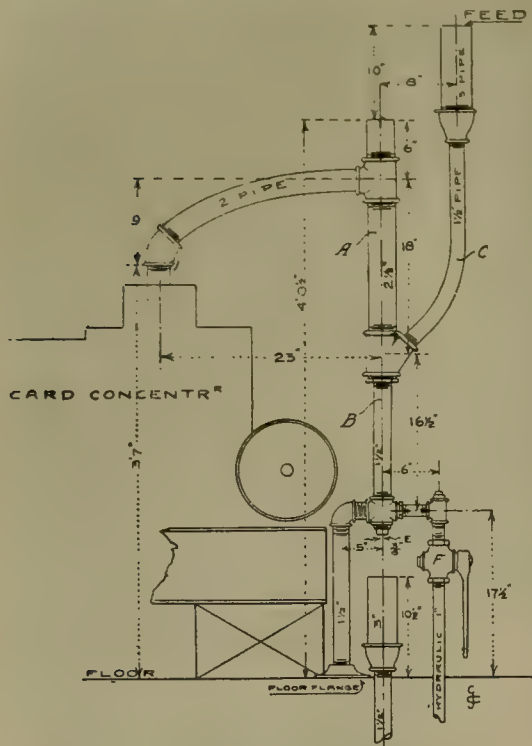
was 111 tons of middling, assaying 16.9% lead and 5.8 oz. silver, worth together \$8.53 per ton, or a total of \$946. Thus the total mill-products weighed 3250 tons, assaying 50.8% lead and 18.3 oz. silver, worth together \$30.90 per ton, or \$100,409 in all.

Operations in the Old South mill were discontinued in 1912, when the second unit of the West mill, called No. 2 West, went into operation. This No. 2 West mill was started on April 17, 1912. It occupied part of the building in which the No. 1 plant was housed and was intended originally as a duplicate. This fact restricted the mechanical arrangements, particularly the sizing system. A description of the plant has been published by R. S. Handy, the mill superintendent, and I take pleasure in quoting from his article.†

The flow-sheet is shown in Fig. 7. It will be seen, as Mr. Handy says, that "there is a gradual reduction in the size of the particles of middlings by means of rolls as far as they are efficient, and, finally, by fine-grinding machines. At each step the freed galena is taken off and the tailings produced by cracking the particles are disposed of before the material is again subjected to reduction. While this complicates the process and makes a large tonnage of middling to be re-handled, it does not result in an excess of slime, as the material is extremely hard. The middlings are not mixed with the original feed until it enters the slime department, and the jigs on the original feed have a uniform load, and are kept up to a high standard of efficiency. Another object striven for is to keep the amount of circulating water as low as possible. To do this, the gradients of the launders have been made ample to carry the products with a minimum of water. The fine trommels are washed with pipe-sprays. The thin streams from these impinge on the ore as it rolls in the trommels and, having a constant head, deliver a constant volume of water into the system. The feed to the rolls and grinding machines is first de-watered, and the wash-water necessary to carry the discharge is applied through spigots with constant heads from the dewatering boxes. The total water recovered from the slime amounts to 372 gallons per minute when treating 550 to 600 tons of mill-feed."

Among the minor features of the milling practice in 1912, Mr. Handy mentions the use of roll-shells made of manganese-steel, trued with carborundum bricks; trommel-feeders for the rolls; the drilling of holes in the bottom of buckets on the fine-elevator to destroy suction; the use of washers made of pure rubber between the buckets and the belt of the elevators, in order to pass the fine sand instead of allowing it to lodge and wear the belt; the air-lift for returning the overflow-water from the bins, etc., for wash-water on the tables; and the complete equipment of all bearings with Keystone grease-cups provided with loose copper pins to automatically feed the grease to the bearing as required; and the use of double-edged or overflow-boxes on the thickening-tanks.

(To be continued)



SKETCH OF PIPE-CLASSIFIER

one machine are generally re-treated on other machines, the function of which is to rectify the work performed by the first one. By this arrangement any faulty operation that has taken place in one part of the mill is detected and corrected in other parts. The only two products excepted are the extreme ones, that is, the highest grade concentrate and the tailing, and these are kept within a large margin of safety."

In July 1911 the South mill treated 20,500 tons, assaying 9.95% lead and 4.2 oz. silver, the combined value being \$11.17 per ton. The products were 318 tons of first-class concentrate from the jigs and 312 tons from the Wilfley tables, the combined tonnage of first-class product being 630, assaying 77% lead and 26.4 oz. silver, worth together \$57.16 per ton, making \$36,011. The second-class product included 1266 tons of second and 375 tons of third classes of concentrate as well as 867 tons of slime, the total being 2508 tons, assaying 45.7% lead and 16.5 oz. silver, making \$25.30 per ton, or \$63,452 in all. There

†Trans. A. I. M. E. (1912), Vol. XLIII, pp. 685-692.

Herbert Hoover: A Sketch

By T. A. RICKARD

Herbert Clark Hoover was born in the town of West Branch, Iowa, not quite 46 years ago, of Quaker stock. He is the son, grandson, and great-grandson of Western pioneers. His father, Jesse Clark Hoover, was a blacksmith and machinist. An orphan at ten, he went to live with an uncle in Oregon. At the age of 14 he went to work in a real-estate office at Salem, and prepared himself for college by studying at night. In 1891, when 17 years old, he entered with the 'pioneer' class of Stanford University, which had just been opened. He worked his way through college by assisting John C. Branner, the professor of geology and later the president of the University; he made a little money also by means of minor business enterprises, including the agency for a laundry. He helped his brother, who likewise entered Stanford; indeed, they helped each other; he also aided a girl cousin to an education. He has always been of the helping kind. At college he was a hard-working, serious, diffident fellow, but co-operative, a leader and an organizer. He used to walk down the campus with his hands in his pockets and his head bent in thought—as he does now. He had no use for fraternities, he was a 'barbarian'; nevertheless he was elected treasurer for the student-body, whose athletic affairs were much in need of financial organization. He placed them on a businesslike basis and performed his duties so well that he won general approval and respect. He has managed bigger affairs since then with the same thoroughness and sincerity.

He had decided already to be a mining engineer; the idea had appealed to his imagination even before he went to Palo Alto, largely owing to a chance encounter with a mining engineer whom he met while in Oregon. During intervals of college life he had served on the staff of the State Geological Survey of Arkansas, under Dr. Branner, and of the U. S. Geological Survey in California, under Waldemar Lindgren. After graduating, in 1895, he went back to Dr. Lindgren, at Grass Valley, California, and remained with him until that season's work was done. Then he got a job in the Reward mine in the same district and later that year he worked in the Mayflower mine, at Nevada City, which is close to Grass Valley. Eager to learn more, and acting on a suggestion from his friend George Hoffmann, he decided to try for an engagement with Louis Janin, one of the leading mining engineers of the country. That was in December 1895. Janin gave him a desk in his office in San Francisco and found work for him to do; he surveyed the Carlisle gold mine in New Mexico and helped in the examination of the Four-Mile placers in northern Colorado, besides other work of increasing responsibility. He made good. These activities occupied the year 1896. When Janin received a cablegram asking him to send a capable young engineer

to Western Australia, he named Hoover. That was in February 1897.

In Western Australia he became engineer on the staff of Bewick, Moreing & Co., who were managers of a large group of important mines. He was put in charge of two or three of them in succession, organizing their operations so as to decrease the cost of production and establish them on a more profitable basis. He had changed but little; he was the same quiet, rather shy, persistently busy young man. It needed no unusual insight to detect his keen intelligence, power of quick decision, and, above everything, the ability to distinguish the essential from the non-essential factors in any given problem. He was both a good appraiser of mines and a capable manager of them.

Late in 1898, when only 24, he was offered the position of chief engineer to the Chinese Imperial Bureau of Mines. He went to Peking and commenced a series of explorations in the interior of China. In 1900 he happened to be in Tientsin during the Boxer uprising and took part in the defence of that city. In 1901 he became general manager for the Chinese Engineering & Mining Co., in which Bewick, Moreing & Co. were interested. A year later he became a partner in the firm and went to London.

In January 1903, soon after he joined this firm, one of the partners, an accountant named A. S. Rowe, misappropriated \$700,000, belonging to sundry West Australian mining companies. In the absence of the senior partner, C. Algernon Moreing, and without legal obligation to do so, Mr. Hoover committed his firm promptly to the re-payment of the missing funds.

He remained with this engineering firm until 1908, and during these six years he examined and directed mines in remote parts of the earth, gaining wealth and reputation. Even when he retired from the firm and opened an office of his own he was only 34 years of age; by that time he had won a commanding position in the mining world. He was elected director of several important companies in Australia, Siberia, and Burma. Early in 1914, just before the War, a group of mining companies got into trouble through the irregularities of their chairman, who went into bankruptcy. The mines affected by the fiasco were the Camp Bird in Colorado, the Santa Gertrudis in Mexico, and the Messina in the Transvaal. In order to allay public anxiety it became necessary to select a man who could command general confidence. Mr. Hoover was selected. He became chairman and continued in that office until 1916, when he resigned all his directorships in order to give the whole of his time to the great tasks to which the exigencies of war and his public spirit had drawn him. Before leaving this

last episode in his mining career, it is proper to lay emphasis upon the selection of Mr. Hoover to restore public confidence in a group of embarrassed mining companies. He owed the honor to force of character, not to any amiability, subservience, or snobbishness. In London he could not be mistaken for anything but an American, and a Western man at that; he was uncompromisingly, even bluntly, American. He won the esteem and the personal confidence of the foreigners with whom he came in contact, but his closest friends continued to be Americans, and he never had any other idea than to re-

eral hundred Latin terms to answer his needs. These had stumped all Mr. Hoover's predecessors. He set to work in characteristic fashion. First he collected other books by Agricola and his contemporaries, and, by comparing contexts, discovered the meaning of the doubtful terms. Not a classical scholar himself, he succeeded in his task by utilizing the services of professional translators and then applying what medieval Latin he had acquired, by his study of the literature of the period, to their renderings. Mrs. Hoover and his brother, Theodore J. Hoover, aided him. His spare time for three years was devoted to



MR. HOOVER AT WORK

turn home as soon as his children were old enough to go to school. Since 1910 he has had an office as mining engineer in the Mills building, San Francisco.

Mention must be made of his contributions to technical literature. His first article appeared in the 'Mining and Scientific Press' of February 29, 1896. The subject was 'Vein-Crossings'. In 1908 he delivered a series of lectures on mining at the universities of Stanford and Columbia, these lectures being cast later into book form and appearing under the title of 'Principles of Mining', in 1909. His literary achievement was the translation of Agricola's 'De Re Metallica', a Latin treatise printed in 1556. The translation, issued in 1912, is a folio of 640 pages, of the same size as the original and bound in vellum. Others had tried to translate this classic volume, but they had failed, chiefly because Agricola coined sev-

this task. The notes he added to the translation by themselves constitute a valuable volume. The publication was done with no idea of profit, the cost of the book being three times the selling-price. It was a remarkable example of initiative, method, and persistence. The Mining and Metallurgical Society of America bestowed its gold medal on Mr. and Mrs. Hoover for this performance.

When the War broke out, in August 1914, there was a big rush of American refugees to London, on their way homeward. Thousands of them were stranded and in trouble. Mr. Hoover and a number of other American mining engineers organized a committee to help their countrymen in distress. Mr. Hoover was the chairman of that committee. The Americans had no sooner effected a clearance than the Belgians began to arrive. The story of their sufferings and of the pitiable plight of their

country went to Hoover's heart; he started measures of relief, at first in a small way, then, on a colossal scale, buying shiploads of foodstuffs. Thus was started the celebrated 'C. R. B.', the Commission for Relief in Belgium. He met with opposition, for he was ever informal in his ways, but when his purpose was understood and appreciated, he received support and money from the British government and grudging recognition from the German officials in Belgium. One of the first things he did, after appealing for subscriptions to the C. R. B. fund, was to have the books of the Commission audited monthly by the leading firm of accountants in London. He put his benefaction on a sound business basis immediately. During the perplexing period before the United States entered the War he had countless difficulties, diplomatic and otherwise, to overcome. He traveled continually from London to Brussels, from there to Berlin and Paris, in his earnest effort to prevent anything from stopping the feeding of the seven millions of unhappy Belgians, on whom the heel of Germany was pressing so hard.

As soon as the United States declared war, he was called by President Wilson to serve as head of the Food Administration. Again he proved his capacity to the hilt, evoking a cheerful response from the American people when they were told to save food, or 'hooverize'. The women of the country, more particularly, rallied to his support. His administration of our food resources is one of the few cheerful features of the management of national affairs during the War. When suddenly the Armistice ended that splendid work, as our declaration of war had ended his work in Belgium, he turned to the greatest of all his undertakings. As head of the American Relief Commission he became economic dictator of more than half Europe. Congress gave him \$100,000,000 to spend; he used it seven times over, feeding the famishing peoples of Europe, and received securities from European governments equivalent to 90% of the fund. The Relief Commission is still feeding 2,500,000 children. When peace was formally concluded at Paris, he came home and prepared his report to Congress. In November 1919 the President appointed him vice-chairman of the Industrial Conference, now in session at Washington, a task to which he is devoting himself earnestly, serving as presiding officer. Last October he was nominated for the presidency of the American Institute of Mining and Metallurgical Engineers, and on February 16, 1920, he was elected. On February 18 he received the medal of the Civic Forum of New York in recognition of his "distinguished public service". Herbert Hoover is the greatest of living Americans; he is the most useful man in the world today.

DURING the past year 8400 men were employed in the mines and quarries of the Province of Quebec. These men have worked for a total number of days represented by 7037 men working a full year of 300 days. Accidents to 346 men, of whom 12 died of injuries sustained, have been reported during 1919. In the previous year, with

6350 men employed, 224 accidents were recorded out of which 29 were fatal. Due to higher wages and to a greater number of men employed in the mining industries an increase in the total of the salaries paid is recorded. During the year 1919 the total sum paid amounts to \$7,312,764, as compared with \$6,149,448 for 1918.

Coal Production of India

The known deposits of coal in British India are limited and the quality is comparatively poor. The annual output has now been raised by some 20,000,000 tons, and it is stated the industry pays handsomely. India, however, is surrounded by countries that could take a great deal of this coal if it could be spared. Indian industries again are but in their infancy and are using practically all the coal mined. There are in addition the railways and the iron and steel industries.

The two iron and steel companies are expanding their business in a most remarkable manner, while a third company, soon to be operating in Bengal, promises also to expand into a great concern. The Bengal Iron & Steel Co. is now producing 120,000 tons of pig-iron per annum and is contemplating large extensions, as is natural in view of its possession of a practically inexhaustible supply of high-grade ore with an iron content of 60 to 66%. The Tata Iron & Steel Co. is similarly circumstanced as regards ore; it has in the 12 years of its existence already left far behind its original program of production, having begun with the modest idea of turning out 120,000 tons of pig-iron annually, whereas its production has already reached twice that figure. It has a present capacity, besides, of producing 17,000 tons of steel per month. Its rolling-mills have capacity for an annual output of 120,000 tons of rails and smaller sections, and it soon expects to be in a position to use up to 1,250,000 tons of coal annually for conversion into coke. This, too, is only a beginning, for, whereas recently the company employed 13,000 men, with another 10,000 at work on extensions, it is contemplating the early layout of an industrial town to accommodate 50,000 persons.

When in addition to the demands on coal by these two works there come into existence the works of the new Indian Iron & Steel Co., a very large amount of good coking coal will be required—and this class of coal is by no means too plentiful in India. The result may be that the price of coal will rise to a higher figure. Then there are other minerals which, the Geological Department states, exist in abundance, and which it is proposed to mine and put to use—manganese, aluminum, lead, tin, copper, and tungsten. When these contribute to the industries of the country further demands will be made on the coal output. But apart from the industries it is certain that general trade will grow enormously in the near future, and with it will come an increased demand for coal. The Indian coal situation consequently deserves serious consideration. The immediate development of hydro-electric resources would take some of the burden off the coal mines.

The Contract Wage System for Miners

By A. K. KNICKERBOCKER

***PRESENT METHOD OF PAYMENT.** Practically all underground work on the Minnesota iron-ranges is done by miners working on a so-called contract wage system. This system, while it has certain advantages over the straight day's-pay or company-account method of wage-payment, has serious and vital defects. In view of the scarcity and demands of labor, it is important that employers of labor scrutinize their systems of wage-payments carefully, not only to save losses and trouble, due to labor disturbances, but also to secure the greatest efficiency of their workmen and reduce their operating costs. It is admitted that an adequate, just, and equitable wage is the prime factor in bringing about these benefits.

The wage of labor and its method of application and payment have been, and always will be, the main factors in the unrest and dissatisfaction of labor. Not only does labor want and need an adequate wage, assuming that work is adequately performed, but it wants and is entitled to a just and equitable wage. Labor must have respect for the fairness of the wage and for the fairness of the management in the application of the wage. It is conceded that the Minnesota iron miners are now, and have been, in the main paid adequately, but the inherent defects of the so-called contract system prevent any just or equitable application of this wage to individuals.

The defects of the contract system, with its obvious inequalities, favoritisms, and injustices, are cancers in the brain of those that labor. Every thinking miner realizes these defects and knows just what they are; the unthinking do not realize the details of the subject, but each month they are forcibly reminded of these defects through the pay-envelope. As practised on the iron-ranges, however, the so-called 'contract' system is not a contract and the name is a misnomer. No true contractual obligation exists.

As usually practised, the contract system involves the setting of a price per foot in development work, or per foot or per car, usually the latter, in slicing or stoping, by the mining captain, and assumes its acceptance, though oftentimes under protest, by the men. A price is set for each working place, in which there are usually two men per shift. This price includes labor and supplies, such as explosives, fuse and caps, shovels, and carbide, and the men divide the total earnings less the amount expended for supplies. The cost of the supplies charged to the men varies in different mines; in some cases supplies are furnished free. In general, the companies furnish machine-drills, hose, steel, picks, rails, cars, timbers, boards, lagging, perform some of the transportation and

all of the hoisting, and may do some of the track work. The miners do all of the shoveling, drilling, blasting, and timbering, and some of the transportation. Supplies chargeable to the men are usually furnished at cost, plus 10% for handling.

In general the rate per foot or per car, or the contract price, is set at the first of each month to govern that month. Earnings are frequently calculated and checked by the mining captain; and many companies also figure the rates on the fifteenth of each month. Some of the contracts will show large earnings, others average earnings, and others small earnings. When the earnings are small, the rate has been insufficient, in which case it is raised, and a new rate governs the remainder of the month; or the contractors have encountered unusual and unexpected difficulties, in which case the contract may be closed and the men paid off at the company-account rate and a new contract started, or they are allowed footage or cars not actually earned; or it is concluded that the men are poor workers or unskilled miners, in which case they are paid off at the company-account rate and discharged, new men are hired, and a new contract started.

DIFFICULTIES OF APPLYING CONTRACT WAGE SYSTEM. The difficulties of the system arise from:

1. The setting of the price, often under protest from the men, by one individual, the mining captain. This price is set to the best of his ability and is based on his mining experience, his knowledge of the men and of the ground, and his opinion of the probable conditions that will present themselves through the month. It is impossible for one individual to set prices equitable throughout the mine. Hard or soft ground, heavy conditions or the reverse, and other difficulties, due entirely to the nature of the work, may be encountered so that the price set by the mining captain is a mere guess.

The human-nature problem enters also, oftentimes unconsciously. For instance, if two gangs of miners, one composed of good men and the other of extra good men, are working under exactly similar conditions, the captain will be tempted to give a slightly lower price per car to the better gang to prevent its 'running away' or securing an abnormally high wage, thus penalizing the better gang or subsidizing the poorer. The captain excuses this practice, to himself and the miners, by fancying some difference in conditions in the two places. Where he is unable to so fancy a difference, he must pay the same rate in both cases; but in that case the rate will be reduced, thereby reducing the earnings of both contracts simply that one shall not make an abnormally high rate.

Furthermore, favoritism develops as another result of the human-nature element. Certain favored, though no

*A paper presented at the New York meeting of the A. I. M. & M. E., February 1920.

doubt hard-working and efficient, miners will receive the best places and get the highest wages month after month. The rule of seniority is not often practised, and is as often overlooked as not.

2. The difficulty in foreseeing, 30 days in advance, what conditions underground will be, and the multiplicity of operations entering into the contract price make the off-hand setting of this price by the captain a mere guessing matter. The ground may change; it may get heavy, be soft or hard and vary within short distances; water may increase; poor timber or heavy ground may necessitate extra timbering; no two tramming distances are exactly alike; the ore may be heavy or sticky or vice versa; and numerous other factors enter to influence earnings. Do all these factors influence the price, each in its proper proportion? They surely may not; but they should, if the miner is to receive pay for work performed. That they do not is no reflection upon the mining captain; he does the best he can, and nobody attempting to make contracts in this guesswork fashion could do any better.

3. Certain other difficulties, by no means unimportant, arise from the nature of the piece-work system itself, and are common to the system as applied in any industry. In many manufacturing plants, the operations of which are standardized and are performed in a routine manner day by day, the same objections apply. The principal disagreeable factor is rate-cutting, after a rate has been set and earnings have been found to be abnormally high. In mining, it works somewhat as follows, assuming that a certain 'gang' has started a new place and that the rate has been set by the captain: The rate will represent his best judgment of what the gang will produce as against his idea of the wage he would like to pay them. This rate may not necessarily coincide with the miners' conception of a fair rate. They are often as experienced and possessed of as good judgment in this matter as the captain. The captain's mere assumption that they will be able to make normal earnings is not necessarily conclusive to them and what they think of the situation, not what the captain thinks, will most probably govern their actions.

After the captain has set the rate, one of three things is bound to happen:

1. The miners consider the rate satisfactory and go ahead and do a good month's work, then

(a) If the rate happens to be satisfactory, they receive a good month's pay and everybody is satisfied. The company has received good production and the miners have had proper pay; this is the ideal condition.

(b) If the rate happens to be high, the miners will make an abnormal wage. This is a frequent occurrence and has a pernicious effect; here, the company loses money on the men. In the first place, the miners who have done a good month's work but who have received an average or below an average pay, do not consider the receipt by this gang of an abnormal wage as at all just; therefore a certain proportion of the force is immediately dissatisfied, with the usual results of demands for higher rates and the uncalled-for quitting of men. Also, as a rule, the rate of the high-wage gang is cut for the suc-

ceeding month with the result that these men are dissatisfied and quit or work in a half-hearted fashion.

(c) If the rate happens to be low, the miners will make a low wage. Here, the company makes money on its men, if it looks no farther than the earnings of the men and the tons of ore produced by them. In reality, it is as much of a losing proposition for the company as either of the others. The men consider that they have worked as hard through the month as any of the other men, so the result is a dissatisfied gang.

2. The miners consider the rate too high, regardless of whether it is or not, and so will not do their best work. They think that to do so will mean that their earnings will prove abnormal and thus lead to rate-cutting at the end of the month. They, therefore, fail to produce a normal output until such time as the captain discovers their attitude and attempts to remedy by either discharging men or setting a new and lower rate.

3. The miners consider the rate too low and either quit or do not give a full measure of work. The less work they do, provided they are not discharged, and to some extent even if they are, makes it more certain that sooner or later the captain will raise the rate. Miners cannot be forced to work, and the captain must avoid low production. If his gangs refuse to work and give him production, he has two remedies. He can discharge the men or he can stimulate them by raising the rates. What he will do in any instance depends on how widely the dissatisfaction is spread through the mine and on the character and supply of miners available.

On the Minnesota ranges, conditions in one mine are not radically different from those in others, yet there is a constant migration of men from mine to mine—an economic loss to both the workers and the employers. Not only is the system economically poor in its effects on labor and on the employing companies, but the influences of the injustices of the system on the mind of the worker make him a fruitful field for the agitator. The system is a constant trouble-breeder and mischief-maker. It allows a continual heckling and disturbing of labor and it will continue to be the prime factor in labor unrest.

SUGGESTED IMPROVEMENTS IN CONTRACT SYSTEM. As a matter of fact, the average miner does not want the system abolished. He prefers it over the day's-pay system, for it allows him to earn by the expenditure of effort, a wage greater than the company-account wage. He knows that to go back to the day's-pay system would cause, in effect, a general reduction in the level of wages. What the miner wants is a contract system based on something more tangible than the autocratic judgment of one individual.

The keynote of the improved plant is standardization, based upon accurate and sympathetically carried out time-studies. No piece-work wage-payments can be made satisfactorily unless each operation is standardized and the time and cost of doing it are definitely known. In other words, we must have, instead of rates set upon individual autocratic judgment, rates determined scientifically and based upon long-continued and accurate

time-studies made by competent and experienced engineers who understand underground conditions.

The business of mining iron ore is not simple, and to handle the matter we will have to divide it into simple operations capable of definite time and cost ascertainment, and classify these operations into two classes—fixed operations and variable operations. The fixed operations are: Shoveling, drilling and blasting, tramping, timbering, boarding-up and blasting-down rooms, and track-laying. These are all fixed determinable factors that, by means of accurate and long-continued time-studies, based upon the work of average miners, would give a determination of the proper pay. These time investigations would prove, for instance, that the average miner can shovel ore to fill a car of certain size for N cents, which amount should then be the price paid for this work all through the mine, until such time as the general level of wages is changed.

Likewise with drilling and blasting; although experience would point the way to the proper method of handling this question. Whether this work should be paid for at so much per car, per ton, or per foot of hole drilled, is a matter that could be worked out at the proper time. This item is also a semi-variable, in that the several kinds of ground must be considered. To handle this successfully, the number of kinds must be kept at a minimum. Five grades are suggested, very soft, soft, medium, hard, and very hard. This is the only item where the judgment of the mining captain is brought into play, or the only chance there is for any disagreement or argument between the men and the captain. Surely the captain should be able to classify any face into one or the other of these five grades, especially as the grades will have been well delineated by the preliminary time-study and investigation work. The system should be worked so that the rate on this item can be changed during the month as often and as quickly as the ground changes from one class to the other.

Similarly, tramping should be paid for at so many cents per car of various sizes tramped 100 ft. or fraction thereof. Timbering would be paid for at so many cents per set. The rate would raise or lower with a change in the length of post or cap or both, above or below base lengths. Boarding-up rooms would be paid for at so many cents per hundred square feet boarded, and blasting-down of rooms would be paid for per 1000 cu. ft. of room blasted-down. Tracklaying would be paid for at so many cents per linear foot for straight track, so many cents per foot for curved track, a lump sum for switches, frogs, and tracks into slices. Since in most mines a good share of the track-work is done by a special track-man this item would not be very important.

The variables entering into the problem are, unhappily, numerous, but the crux of the whole problem lies in the treatment of these variables. The variables include all those items that cause a loss of time to the miner and prevent him from using his time in one or the other of the above six fixed operations. These delays should be classified into two well-defined classes: those for which

the miner is responsible and which could have been avoided by ordinary skill or foresight on his part, and those that are in no way under his control and are due to neglect of the company or accidents due to the nature of the work, such as unforeseen caves or falls of ground. For the first class, the miner should receive no pay. For the second, he should automatically go upon company-account pay the minute that he starts to suffer delay and be paid for all the time he is so delayed. This company-account rate should be made low so that advantage will not be taken of it, and also because there is presumably little or no expenditure of effort in most of the cases coming under this classification.

The contract sheet at the end of the month would then look something like this:

To shoveling A cars, A size, at a cents per car.....	_____
To tramping A cars, A size, 300 ft., at b cents per car per 100 ft.....	_____
To drilling and blasting, soft ground, at d cents per car (or foot of drift).....	_____
To timbering, E sets, 7-ft. post, 6-ft. cap, at e cents per set	_____
To boarding-up rooms, F sq. ft. at f cents per 1000 sq. ft.	_____
To blasting-down rooms, G cu. ft. at g cents per 1000 cu. ft.	_____
To H hours delay, waiting for full chute, at x cents per hour	_____
To I hours delay, blasted-down sets, no pay.	
To J hours delay, no air, at x cents per hour.....	_____
To putting in K props, at k cents per prop.....	_____

Supplies could be handled in the usual way and be included in the standard rates, or supply standards could be adopted, supplies furnished free, and savings made by efficiency on the part of the men divided between the company and the men, on an equitable basis.

The plan as outlined is still a straight piece-work system. Whether it would be advisable to develop a standard day's work and standard day's pay and encourage efficiency by the installation of some sort of bonus payments is a matter that would develop as the system was worked out and put into practice. The introduction of bonus-payments would be a complication to avoid until such time as the improved piece-work method has received a good trial, become stabilized, and found favor. It is believed, however, that a bonus for attendance, or the granting of a shift or half-shift per month for full or nearly full attendance during the month, would help to keep the working force full each day and is an application of the bonus system that might be instituted immediately upon the adoption of the improved piece-work system.

A little more clerical work would permit of the calculation of the earnings of each contract each day, with a daily posting of earnings in the change-house, where they could be observed by the men. As a stimulation to a man to put forth increased efforts, there is nothing like knowing what his present efforts are actually bringing him

and an immediate knowledge of his earnings each day. Whether such a step is advisable or will pay for itself is open to experiment after the system is in proper working order.

DISADVANTAGE OF PROPOSED SYSTEM. The disadvantages of the suggested system are, of course, items of cost, due to the extra supervision and time-keeping, and the necessity for frequent check-ups by the management. In a small mine, the details could be looked after by the shift-boss, but a mine of any size would require men doing nothing else but checking time and looking after the operation of the system. It is believed that the extra labor would earn its money, as the operation of the system would be, in effect, a continuation of the preliminary time and cost studies, and it is felt that the system would present facts of operation in such a manner as to quickly uncover the weak spots of an operation and suggest means for the application of suitable remedies. For instance, the daily records would show that some gangs were above the average in certain lines of work and below the average in others; steps could then be taken to discover the gang's difficulties and by education improve the production and earnings of the gang and lessen the cost to the company. Certainly it would mean a detailed and accurate cost system applied where it should be applied, to the man actually producing the ore, and it is inconceivable that the system would not furnish to the captains and superintendents a ready and up-to-date means of detecting weak spots in their operations and determining quickly and accurately the means of correcting them, and thus lead to a general reduction of costs.

Another disadvantage is that the system could not be put into operation without some initial and preliminary time-studies and investigations performed on average men and under widely varying, though typical, conditions, and under supervision of men sympathetic to improvements. The longer this work is continued prior to the adoption of the system, the more accurate and fool-proof it will be. These investigations can best be made by the large companies, having various mines and with large organizations equipped for the work. The cost would be prohibitive to a small company. This preliminary investigation would no doubt take two or three years' time and cost some thousands of dollars, but the savings made on the millions of tons of ore mined and shipped each year would repay the cost many times over, as a result of the knowledge obtained, even should the work stop with the preliminary investigations.

ADVANTAGES OF PROPOSED SYSTEM. The advantages are numerous and have previously been indicated, but for convenience will be here summarized briefly: (1) Prevention of disputes; the basic rates for each operation would be standard throughout the district. (2) Less dissatisfaction among the men. (3) Less opportunity for the strike-agitator. (4) Better work by the men, due to the fact that they would see that unfairness and injustice had been abolished and would feel that they were getting paid fairly for work performed. (5) A smaller labor turnover. (6) A reduction of operating costs to the

companies. (7) Opportunity for increasing the efficiency of the men and the improvement of operating conditions and methods, due to detailed costs presented quickly and the knowledge obtained from them.

The suggested system may not be the best, and it is not expected that any fair system can be derived without actual study and experimental trial, but in the interests of both the men and their employers, some steps should be taken to improve the present system.

MANGANESE deposits have been known in Panama for many years, and some were extensively worked as early as 1871. None was recorded in Costa Rica, however, until 1915, when American engineers found deposits in western Costa Rica and, under the stimulus of the prevailing high prices, explored many of them. During 1916, 1917, and 1918 about 18,000 tons of ore was exported from Costa Rica to the United States. In October 1918, the U. S. Geological Survey, taking advantage of the presence in Costa Rica of an American geologist, J. D. Sears, had the deposits examined. Dr. Sears afterward visited several new deposits in Panama. The deposits in Costa Rica are found at several places on the Nicoyan peninsula, in the Province of Guanacaste, which extends along the Pacific Coast. Most of the known deposits, and all those which have been the source of the shipments, lie within about 16 miles of Playa Real on the Pacific Coast in the northern part of the peninsula. Although deposits of manganese oxides were examined at 36 places near Playa Real, most of the ore shipped has been derived from three deposits that lie in an area scarcely 1000 ft. square at Playa Real. These deposits are owned by the Costa Rica Manganese & Mining Co., an American company. At Playa Real, as at many other places in the region, the manganese oxides form very irregular masses, which appear to extend along the crests of hills. The genesis of the deposits is obscure, but sufficient work has been done to show that only a few feet for as much as 100 ft. below the surface. Estimates of the size of the known deposits, which, however, are based upon very inadequate data and are therefore probably low, indicate that they might yield 10,000 to 15,000 tons in addition to the 18,000 tons already shipped. The oxides are intimately mixed with silica, so that careful sorting is necessary to produce material containing more than 45% of manganese. After the oxides are sorted they are carted to wharves on the coast and carried by lighters to ships anchored near the shore.—U. S. Geological Survey.

A MINER speaking a foreign language seeks employment from a foreman who can talk to and direct him only in English. He goes underground, where all printed signs are written in English. He receives spoken warnings of dangers and of dangerous conditions from an underground boss, also in English. If he does not make an earnest effort to learn this language he not only puts his own life in danger, but his mistakes through misunderstanding orders may imperil the lives of others.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

OPERATION OF GADSDEN MINE IS DISCONTINUED.

JEROME.—It is reported that development on the Silver Tip claim of the Green Monster Copper Co. will be resumed soon. Several winzes are to be sunk to explore the veins opened by previous development on the Silver Tip claim. The Calumet & Arizona Copper Co., chief owner of the Gadsden property at Jerome, shut-down the mine on March 25. Diamond-drilling on the 1200-ft. level had already been discontinued. The pumps are to be drawn and the track taken up. It is estimated that three-quarters of a million dollars has been spent in development work. It is thought that operations will be resumed when the copper market improves. At a recent meeting of the board of directors of the Peak Silver Mining Co. plans were formulated for the future development of the Black Horse group of claims which are located on the Prescott-Crown King road. The Black Horse property has not been worked since 1890. The contract for the sinking of the Venture Hill-Verde Apex shaft from the 280-ft. level to the 500-ft. level has been taken by E. L. Bartholomew.

KINGMAN.—Reports from the Telluride mine at Oatman are encouraging. It is said that the cross-cut on the 430-ft. level has entered 16 ft. of mill-ore, 4 ft. of which assays \$26 in gold, and that small streaks sample as high as \$300 per ton. Drifting is now being done along the richer sections of the vein. It is reported that the Martin Brothers, who have purchased all rights in the Harqua Hala mines near Wenden, are making preparations for sinking the shaft to the 400-ft. level. Recent work in the old workings has opened ore similar to that taken out in the early history of the mine and this ore is to be developed by winzes and drifts.

PATAGONIA.—The new shaft of the Hardshell Mining Co. has now reached 435 ft., although water continues to give trouble. The rock taken from the shaft is mineralized quartzite and porphyry and assays 3.4 oz. silver. Indications seem to warrant the belief that the ore-zone will soon be reached in the shaft. Recently, shipping ore has been discovered on the Bender group of claims adjoining the Hardshell group, a 3-ft. vein of 36-oz. silver ore having been encountered at a depth of 17 feet.

PHOENIX.—The annual meeting of the stockholders of the Arizona Gypsum Co. was held at Phoenix, March 1. The report of the secretary showed that sufficient money had been raised to proceed with the construction of a gypsum-plant for the manufacture of all grades of wall-plaster, solid and hollow building-blocks, and fertilizers.

It is estimated that the plant will cost \$25,000 and will be capable of handling 200 tons of raw gypsum per day.

PRESCOTT.—At the annual meeting of the Kay Copper Co. the president reported that there is now \$6,000,000 worth of ore in sight in the Kay property and that several large bodies of ore had been discovered by the diamond-drill. The shaft is making progress and at the 1000-ft. level a cross-cut will be driven to open the main orebody.

RAY.—According to a circular letter to the stockholders of the Magma Chief Copper Co. exploration on the 300-ft. level of the Sombrero Butte property is progressing satisfactorily, the main drift in this level being in 60 ft. of high-grade ore. This ore is also exposed on the 220-ft. level.

COLORADO

THE ISABELLA MINES CO. WILL RE-BUILD.

CRIPPLE CREEK.—Directors of the Isabella Mines Co. at a special meeting held in Colorado Springs, have determined to change the base of operations from the Lee shaft to the Empire State shaft, situated at about the centre of the group. The Lee shaft-house and machinery were recently destroyed by fire of unknown origin, entailing a loss in excess of \$100,000 with insurance of about \$25,000. The Empire State shaft now 1100 ft. deep will be sunk 235 ft. further, to correspond to the 15th level of the Lee, at a depth of 1275 ft. Two new cables 1600 ft. long have been ordered and will be wound at the Empire State shaft immediately upon delivery when sinking will be started. All lessees, ten in number, will be given extensions of their respective leases. The Isabella Leasing Co., recently organized by stockholders of the parent company, had just cut the Larson vein, about midway between the Lee and the Empire State, and grab-samples are said to be above average. The change to the Empire shaft should prove beneficial, as the virgin ground to the west can now be exploited at comparatively small cost. The Maloney and No. 2 veins of the Isabella system will be thoroughly exploited by the Isabella Leasing Co., holding a five-year lease. The Lee will not be entirely abandoned and an electric hoist will be erected for use by the lessees who were mining a good grade of ore from the second level.

LEADVILLE.—Ore from the Ixib mine, shipped by lessees to the smelter of the A. S. & R. Co., was reported to be so rich in metallic gold that approximately 100 oz. of the yellow metal was caught when the crushed ore was screened preparatory to smelting. This rich discovery

was made at the No. 2 Ithex shaft, and while the rich streak is no longer producing as much as when the strike was first made, the lessees are still sacking ore.

The Hilltop discovery, made last fall, is holding up and is pronounced by Sam Doran, superintendent, to be the greatest thing in years. The miners employed during the winter have blocked out an orebody 12 ft. wide and 300 ft. long for more than 50 ft. vertically. Ten tons daily is now hauled to Fairplay for shipment, but with roads open to Leadville 50 men will be employed.

MONTANA

ANACONDA COMPANY HAS ELABORATE PLANS FOR SAFETY WORK.

HELENA.—In the Nigger Hill section west of the city the following mines are now producing ore: the Julia, the Charter Oak, and the Big Dick. In the Julia work of unwatering the mine has been completed, and the shaft is now being sunk from the 300 to the 400-ft. level. An air-compressor and hoist have been put in place. Two carloads of ore recently shipped from this property gave satisfactory returns. The Charter Oak mine, of which F. W. Hopkins is manager, is producing high-grade lead-silver ore, and a shipment will soon be made to the East Helena smelter.

Lump Gulch, 12 miles south of here, is developing activity. At the Liverpool mine a new discovery was made on the 750-ft. level a few days ago. This new orebody is about five feet in width, and averages 40 oz. silver per ton. The Free Coinage mine, another famous producer of silver in the past, has been re-opened and is now producing high-grade ore. This mine is being operated by the Amalgamated Silver Mines Co. Another producer in this locality is the King Solomon mine, operated by P. A. Danaher and Chicago associates.

BUTTE. The plan of the Anaconda Copper Mining Co., which will involve the expenditure of \$1,500,000 for systematic organization to eliminate mine hazards at its properties, has been started with the appointment of the following safety and ventilation engineers: L. Smith, at the Mountain Con. mine; C. G. Sullivan, Belmont; W. W. Hanson, Steward; E. Hogan, Poulin; R. D. Sultz, Tramway; J. Trewin, Silver Bow; A. C. Bigley, Berkeley; F. W. Standberg, West Gray-Rock; W. S. Bates, Mountain View; A. C. Stevens, Pennsylvania; L. Wells, Leonard; C. W. Cole, West Colusa; F. Galtke, East Colusa; R. Ryburn, Badger; H. J. Wiggstein, Nettie; C. O'Brien, Emma; and R. Richards, Alice. These men will also look after first-aid and mine-rescue work at their respective mines and co-operate with A. S. Richardson, ventilation engineer, and J. L. Boardman of the Bureau of Safety. Paul A. Gow, general manager for the Tuolumne Mining Co., reports satisfactory development work on the 1200-ft. level of the Main Range group. The copper and silver ore on this level shows improvement over that obtained on the 1000-ft. level. Two ore-shoots on the Spread Delight vein were opened while cross-cutting in the direction of the Rory O'Moore vein. The Rory O'Moore had a width of 15 ft. on the

700-ft. level. Ore from the Spread Delight vein assays \$10 per ton. As soon as the 500-gal. electrical centrifugal-pump is in place on the 1200-ft. level, the shaft will be sunk to a depth of 2000 ft. As the shaft goes down cross-cuts will be run from the 1600 and 2000-ft. levels and then from the 1400 and 1800-ft. levels; 100 tons of ore is being hoisted daily, with 75 men employed.

GREAT FALLS. At the Great Falls works of the Anaconda Copper Mining Co. increased activity is evident in all departments. The ferro-manganese plant will soon operate at full capacity. While only one copper-furnace is working at present, four others will be operating as soon as the necessary repairs can be made. The zinc-department is expected to respond to the attractiveness of the spelter market by making a new production record this month.

LIBBY. Cady, Sheffield & Criderman are planning extensive prospecting on their Automobile group of claims. The Gold Copper property has been traced as the source of the placer gold in Libby creek. H. Brink, W. M. Cady, and A. W. Launsbury are making good progress in developing their group of claims. A 9-ft. vein of quartz heavily flecked with gold-silver has been found on the Lukens-Hazel claim. Good results are expected at greater depth. By dropping to the level of the creek and drifting on the vein a 700-ft. back can be obtained under the present surface opening.

ALHAMBRA. The Carbonate Chief Consolidated Mining Co., backed by Helena and Philadelphia capital, is working the Carbonate Chief, Bell, and other claims from two tunnels. Smelter shipments are expected to commence soon.

NEVADA

GOLD PRODUCERS SEEK SUBSIDY.

MINA.—The main working-shaft on the Simon silver-lead property is now down beyond the 485-ft. point. The last 70 ft. has been driven on ore. This is the first definite proof that the large orebodies developed on and above the 400-ft. level extend to greater depths. Nothing but ore is being hoisted. Cross-cut 603 has been driven for the last 30 ft. through ore with a full breast showing. Drift 607 which also shows a full breast has been driven through ore for 47 ft. Lloyd White, of the firm of Burch, Hershey & White, visited the property recently to check up on the development work. The firm is engaged in working out the flow-sheet of the mill that is to be built.

On the Simon Contact Mines property the shaft is now down beyond the 300-ft. point. It will be sunk to 400 ft. before lateral work is started. Two shifts equipped with machine-drills are employed.

On the Fagan Consolidated Silver property the shaft is down 100 ft. A station has been cut and a cross-cut now out 16 ft. is being driven to cut the fissure in which the ore was found on the 44-ft. level. The orebody which rakes to the north-east dipped out of the shaft at the 50-ft. point.

TULE CANYON. A humorous, yet pathetic, spectacle is the well-equipped 25-ton milling-plant, including a

24,000-gallon water-tank, now standing complete at a 60-ft. shaft on claims at the upper end of Tule canyon. The vein in the claims was thought to be an immense low-grade deposit of gold ore, the estimates being based on pannings, but after six months work and the expenditure of sufficient money to break the backers of the venture, a few assays have disclosed the fact that the pans did not contain gold. The pannings were taken by old and experienced miners, who persisted in building the mill after early assays had shown no gold, their theory being that the ore would 'pan, but not assay'. This supposed remarkable characteristic of the ore was not explained to

Among the directors are John R. Davis and Harry Stimler. Stimler is general manager.

ARROWHEAD.—It is reported that the final payment on the Arrowhead has been made, which will permit the company to ship a large tonnage of ore sacked at the mine. Sinking of the new shaft soon will be started and it is planned to sink the old shaft an additional 100 ft. The west cross-cut on the bottom level of the Consolidated has penetrated a vein 5 ft. wide assaying \$56 for this width. A drift from the west cross-cut is being driven in a 12-ft. vein yielding low assay returns.

MONTEZUMA.—The shaft of the Montezuma Silver



THE 'ORIGINAL' MINE OF THE ANACONDA COPPER COMPANY AT BUTTE

their financial backers by the miners until the mill was near completion and it was finished in the hope that it could be sold. It is said that there is not a ton of ore in the claims on which the plant stands and southern Nevada mining engineers say the venture is unique, as never before in the history of mining has a 25-ton mill been built and a 60-ft. shaft sunk in a vein in which there is no ore. The principal loser says of possible future ventures in mining: "Never again without an engineer." The first payment of \$10,000 on the Ingalls has been divided into three parts and \$4500 has been paid. Work of increasing the capacity of the mill has been started. It will be the policy of the company to let numerous leases on liberal terms. The company that has taken over the mine is the Silver Hills Nevada Mines Co., incorporated for 1,500,000 shares. The officers are: W. J. Loring, president; Edward A. Clarke, of Boston, vice-president; C. H. Beesley, of San Francisco, secretary-treasurer.

Mines Corporation has been sunk 15 ft. in the rich ore-shoot recently opened at the 165-ft. point. The ore is wider than where it was entered and the value is lower, but for 15 ft. the shaft is in material of high shipping-grade. Shipments from the new find have not been made because of deep snow on the road to Goldfield, the shipping point. A number of deals are pending for the sale of nearby claims. The ore contains considerable copper and the zinc content is increasing.

TONOPAH.—At a meeting of Nevada gold producers a resolution was adopted advocating a tax on gold used for other than monetary purposes, the amount of the tax to be given to the producers. The meeting was addressed by Bulkeley Wells, president of the American Mining Congress, and Fletcher Hamilton, State Mineralogist of California. A committee was appointed to form a Nevada chapter of the American Mining Congress and to raise the Nevada quota of \$5000 for support of the McFadden

bill which was recently introduced in the House of Representatives.

GIBRALTAR.—A tunnel 100 ft. lower than that being driven in the outcrop of the vein has been started by the Gibraltar and at 22 ft. the average value of the ore in the face is \$50.

DIVIDE.—The cross-cut being driven on the 400-ft. level of the main shaft of the Divide Extension to open the downward extension of the ore-shoot found in the Caldwell shaft is close to the objective, according to unofficial reports. At the recent Tonopah Divide meeting, which was postponed, George Wingfield had a voting strength of 850,000 shares of the 1,010,800 issued. Sinking of the shaft has been discontinued at a depth of 780 ft. until more powerful hoisting-equipment can be secured. The Sherwood Aldrich-Hayden Stone interests have bought 100,000 shares of the treasury stock of the Belcher, according to official reports. Forty tons of ore recently shipped from the Belcher Extension gave a net return of \$900 and a shipment from the east drift on the 85-ft. level of the Belcher is being prepared. This drift is being driven into Belcher territory from the No. 1 shaft of the Belcher Extension. There is estimated to be 700 tons of ore of shipping grade exposed in the Belcher Extension.

UTAH

NEW CONSOLIDATION OF MILFORD PROPERTIES.

ALTA.—Stockholders of the Alta Consolidated Mining Co. at a special meeting on March 22 voted to increase the capital stock from 600,000 to 1,000,000 shares. The increased stock will be put in the treasury and used to finance the further development at Alta and to clear the company of present indebtedness. It is said that arrangements have been made for financing extensive development for the coming summer through the sale of treasury stock.

PARK CITY.—It is reported that with the last settlement check for January and February, the Daly-West company earned during two months more than sufficient to meet dividend requirements for six months. Since the first of the year the company has been shipping high-grade ore. One lot of 100 tons, recently shipped, averaged \$165 per ton. This is some of the best ore that the property has ever shipped. The shipment amounted to 202,842 lb. and averaged 0.07 oz. in gold, 102.75 oz. silver, 23.6% lead, and 3.47% copper. The Judge Mining & Smelting Co. in its annual report, which is just being mailed to its stockholders, reports that, although hampered by a strike which lasted nearly two months, the company did 2471 ft. of drifting and cross-cutting, and 505 ft. of raising; mined 43,107 tons of ore, and ended the year with a cash balance of \$148,385, as compared with \$72,180 a year ago. The discovery of high-grade milling ore in the foot-wall of the Daly vein was one of the development features of the year. The present rate of production of zinc concentrate, together with the tonnage on hand, assures a capacity run of the electrolytic zinc-plant for the year 1920. Since the first of the year

better prices have prevailed for zinc and approximately 500,000 lb. has been sold and is on its way to the market.

EUREKA.—An assessment of one cent per share has been levied on the capital stock of the Uncle Sam Mining Co. The assessment is delinquent April 22 and sale date has been set for May 17. Seventeen mines in this district shipped 149 cars of ore during the week ending March 19, as compared with 163 cars shipped the previous week. The Chief Consolidated had an output of 40 cars; Dragon Consolidated, 24 cars; Tintic Standard, 20; Colorado, 13; Eagle and Blue Bell, 13; Iron Blossom, 7; Mammoth, 6; Victoria, 5; Gemini, 5; Grand Central, 4; Centennial Eureka, 4; Bullion Beck, 3; Eureka Hill, 1; Swansea, 1; Empire Mines, 1; Sunbeam, 1; Victor Consolidated, 1.

The work of sinking the new shaft at the Chief Consolidated Mining Co. has been stopped temporarily at 1165 ft. in order to permit carrying the concrete-work down to the 1145-ft. point. The shaft-work is reported as progressing more rapidly than it was some months ago, owing to a decrease in the flow of water. Much of the water, which was developed in sinking the first few hundred feet of the shaft, is draining off through the 1000-ft. connection and the present flow is not in excess of 65 gallons per minute. It is anticipated construction of the branch railroad to the Iron King property will be completed within the next few weeks, at which time the shipping of ore, which has already been blocked out, will commence.

At a meeting held recently, the following new officers were selected for the Independence Mining Co.: Alex Mattson, president; P. J. Fennell, vice-president; Harold Schriver, secretary; Robert Kallander, treasurer. The other directors are W. F. Schriver and Enoch Newman. The company has awarded a contract for its main working shaft, which is now down 110 ft. The machinery is said to be sufficient to operate several hundred feet deeper and all necessary buildings have been erected. Up to this time the company's expenditures have amounted to about \$28,000, and, while the present indebtedness is in the neighborhood of \$10,000, there is due the company, for stock sold on the installment plan, about \$23,000.

MILFORD.—At a meeting held March 22, the stockholders of the Moscow Mining & Milling Co. ratified the action of their board of directors in agreeing to a consolidation of their property with the Red Warrior and Beaver Combination properties. Articles of incorporation for the new company were also ratified. The new company will be known as the Moscow Silver Mines Co. with a capitalization of 2,500,000 shares. Of this 1,000,000 shares will be exchanged for the Moscow property; 600,000 for the Red Warrior, and 500,000 shares for the Beaver Combination. Arrangements have been made for the underwriting of 300,000 shares in New York. The officers of the new company are: Fred J. Leonard, president; F. J. Hagenbarth, vice-president; M. B. Johnson, secretary and treasurer; Garrett S. Wilkins, general manager. These with Angus Buchanan of Long Beach, California, will constitute the directorate. The consolidation will

take in about 300 acres of promising ground. It is expected that within thirty days after work is resumed the company will be shipping ore again; work having been suspended pending negotiations.

PHILIPPINE ISLANDS

DEVELOPMENT OF MAGMA PROPERTY.

MOUNTAIN PROVINCE.—Development of the Magma property in the Benguet mineral zone is progressing on three parallel quartz lodes that strike north and south. The outcrop has been traced for more than one mile. Work was begun in November 1919 and so far has been confined to trenching and to adits at, or immediately below, the surface. The outcrops and their float which cover some five acres show a consistent average value of \$3 per ton, and it seems from indications in the old Igorrot workings that the surface had been carefully picked over for higher-grade quartz. Below the surface, however, the assays point to the presence of high-grade ore. The average value of all samples taken from the orebodies below the outcrop to date is \$33.37 gold and six ounces silver. The latter seems to occur in a ratio of four ounces of silver to one of gold. Of these samples four, taken across 15 ft. of hard quartz, averaged \$23.60, while one taken across 12 ft. of quartz and manganese showed a value of \$101.60. The lower tunnel recently started is 705 ft. vertically below the outcrop, thus affording not less than 1500 ft. of backs. Although there is not a ton of ore 'blocked' on this property the exposure of the lodes on the hillside from the camp to the creek indicate a large amount of possible ore.

An abundance of good pine timber is available for mining and other purposes on the ridge adjoining the eastern limit of the property. There is from 6 to 8 million board-feet of lumber within easy hauling distance of the proposed mill-site. Native contractors will deliver this at the following prices: round posts 10 in. to 12 in. by 7½ ft. long, each 30c.; round caps 10 in. to 12 in. by 5 ft. long, each 20c.; split lagging, each 3c. Some three miles south of the claims, at a stream junction, a hydro-electric plant can be erected which will produce from 500 to 1000 hp.; and five miles east, on the River Agno, power can be obtained in any quantity up to 30,000 hp. The Philippine government has temporarily reserved the entire Agno basin with the idea of establishing hydro-electric plants for power and light purposes. There is, however, a sufficient supply for mining operations.

The Magma is 15 miles south of the city of Baguio, 5 of which can now be traversed by automobiles. Beyond this point is a government horse-trail for six miles, from which a native trail connects with the mine. While skilled labor is not plentiful, there has never been a shortage for mining purposes up to the present. There is, moreover, a constant supply of native tribesmen, Ifugaos, Bontoes, and Lepantos who, when trained, become fairly good miners. Unskilled labor today costs from 40 to 50c. (gold) per day and skilled labor from 60c. to \$1, which makes the labor cost of operations low.

BRITISH COLUMBIA

THE PROPOSED NEW PLACER ACT.

VICTORIA.—The provisions of the proposed legislation to amend the Placer Mining Act may be summarized as follows: In respect of leases, now in arrears for more than one year's rental, the lessee may apply before January 1, 1921, for the consolidation of the annual rentals in arrear and arrange for their payment by annual installments extended over a period not exceeding ten years. Where the arrears are consolidated, the failure to pay the annual installment or the current annual rental when due will automatically result in a forfeiture of the lease. Where the lessee so in arrear fails to apply for consolidation and fails to pay the arrears before January 1, 1921, his lease is forfeited. Provision is made for the issuance of leases, beginning July 1, 1920, at a reduced annual rental and reduced annual expenditure for development



MAP OF BRITISH COLUMBIA

work. The changes in fees in connection with the taking-up and maintaining of leases follow: Hydraulic lease, \$25 instead of \$50 per annum, and development \$250 instead of \$1000 per annum; creek lease, \$37.50 instead of \$75, and development \$250 instead of \$1000; dredging lease, \$25 instead of \$50 per mile and development \$250 instead of \$1000 per mile per annum, the value of any new plant or machinery employed to count as money expended on development; and 50c. royalty to be charged against every ounce of gold recovered.

The D'Arcy Exploration Co., a subsidiary of the Anglo-Persian Co., is again making application for an oil concession in the Peace River country.

PRINCETON.—Construction operations at the Allenby and Copper Mountain properties will be resumed by the Canada Copper Corporation about April 1. It will be

possible then to start laying track on the new railway from Allenby to the mine, as the grading will be complete. The bridge timbers are being framed at Princeton and will be forwarded to Allenby for distribution. H. R. Van Wagenen, general manager, and Van H. Smith, metallurgist, who have been wintering in the United States, will return soon.

GREENWOOD.—The Providence mine continues to ship. Two cars have been dispatched this month, aggregating 75 tons, most of which was taken from the 400-ft. level. The value is placed at \$14,000. Development now is in progress on the 500-ft. level where there is considerable high-grade ore in sight.

STEWART.—Definite information is available regarding development plans on the Big Missouri group in the Salmon River district. There will be let a diamond-drilling contract for 12,500 ft. Two camps will be maintained throughout the season. The erection of a concentrator and of other equipment will follow, providing the exploration and development give satisfactory results.

TRAIL.—The Consolidated M. & S. Co. is gradually closing down its Emma mine, at Coltern. This mine has produced over 200,000 tons of ore, 47,314 tons being mined in 1918. Up to date during the present year it has shipped 7900 tons. The ore, however, always has been more valuable as a flux for the company's other ores than as a source of copper, the metal content often barely paying the expenses of mining and transportation. No development work was done last year, so, evidently, the company has been contemplating the closing of the mine for some time. The Consolidated company has declared its usual dividend of $2\frac{1}{2}\%$ for the quarter ending March 31. The cessation of stoping at the Consolidated company's Rossland mines has had a marked effect on the smelter ore-receipts, which, during the past three weeks have fallen off from 30 to 40%.

ONTARIO

SUPPLY OF MINERS AT KIRKLAND LAKE IMPROVES.

TORONTO.—Prospecting throughout the mining regions of northern Ontario promises to be active during the coming season, with a larger number of men in the field than for some years past. The opening of new camps has encouraged the belief that further important discoveries will be made in new or partly prospected areas, and the readiness of capitalists to invest in promising prospects, as shown by the number of new enterprises started in the Boston Creek, Gowganda, Kirkland Lake, and other new fields, has given a decided stimulus to prospecting. The proposed changes in the Mines Act recently announced are meeting with some adverse criticism. The amendment will reduce the fee for staking claims from \$10 to \$5 for those acting on their own account, but will increase it to \$15 where claims are staked on behalf of another. This is not favorably regarded by those who 'grubstake' prospectors, as is frequently done by workmen in operating mines.

COBALT.—The annual statement of the La Rose shows that the company has somewhat improved its position.

The net profit for the year was \$51,736 as compared with \$45,544 in 1918, and the total surplus increased from \$456,046 to \$514,424. Production was maintained in the La Rose from pillars and old stopes, the enhanced price of silver rendering it profitable to work some sections, which could not previously be operated to advantage, and a limited output was obtained from the Violet property. Edwards & Wright, Ltd., which is operating the old Green-Meehan mine, shipped ore during 1919 amounting to 1218 tons, containing 72,569 oz. of silver of the gross value of \$86,648. The Mining Corporation of Canada is extracting a fair amount of high-grade in taking down the party walls between the Buffalo and its other property. It is also obtaining a fair tonnage of milling ore from the Buffalo but has not encountered any new high-grade veins.

The proposed merger between the Adanac and the Victory silver mines has taken a favorable turn, and it is officially stated that operations on the Hylands property of the Victory company to commence in the early spring are practically assured. The basis of the proposed merger is the organization of a new company with an authorized capital of \$3,000,000, one-third to be allotted to the present Adanac shareholders, and one-third to the owners of the Victory property, leaving the remainder for sale to finance development work. Porcupine Crown has resumed production after having been idle since July 1918. With sufficient broken ore to keep the mill running for at least six months, no difficulty is expected in maintaining production at full capacity. Of the 11,609,781 oz. of silver produced from the Cobalt mines during 1919, 5,843,639 oz. was refined in Cobalt, 4,420,538 oz. at Southern Ontario smelters, and 1,345,604 was shipped to plants situated in the United States.

KIRKLAND LAKE.—The working forces of the mines have been considerably increased, many men having been sent here by the Ontario Labor Bureau at Cobalt. A large proportion of these are returned soldiers. The mining companies have put into operation the same wage scale as that adopted in Porcupine, namely, \$4.25 per day for loaders and \$4.75 for miners. At the Ontario-Kirkland about 1000 ft. of lateral work has been done, developing two ore-shoots, one about 200 and the other 100 ft. long, the gold content of which is stated to run from \$10 to \$20. The Pinelle Kirkland Gold Mines, Ltd., has been organized, capitalized at \$4,000,000, to operate the Pinelle group of claims of approximately 700 acres in the eastern part of Lebel township.

MATACHEWAN.—Underground work on the Matachewan mine has been suspended. It is understood that the management has decided to wait until electric power is available before resuming development work. Diamond-drilling will be carried on in the meantime, a contract for 4000 ft. having been let. On the Lake Matachewan property, adjoining, a number of holes have been drilled and the results of assays are stated to be satisfactory. The option held by New York interests on the Robb-Clemens group of claims has been abandoned, as exploration by diamond-drilling failed to show favorable results.

THE MINING SUMMARY



ALASKA

Seward.—Old-time Alaskan miners are preparing to take part in the rush this spring to the new gold-diggings in the Kuskokwim district. Many already have come north in order to take advantage of the sledding conditions of March to get into the district before the ice softens. It is a 600-mile trip by dog-team from Seward to the diggings. From Seward to McGrath, the nearest postoffice and supply point, it is 400 miles. The trail to McGrath follows Rainier pass over the Alaska range to the headwaters of Salmon river, and then up the Kuskokwim river to the trading-station. From McGrath to the diggings discovered last fall it is 200 miles. Prospectors remain at the diggings until supplies are exhausted before making the trip back to McGrath. In March the ice is in such a condition that dog-teams can travel 60 miles per day. In April the ice softens and remains in this condition until June when it goes out and navigation between Seward and McGrath is resumed.

CALIFORNIA

Amador County.—Velles Varrain was killed by gas in the Argonaut mine on March 25, and two other miners had a narrow escape when they descended to the 4500-ft. level to ascertain how much water was in the main shaft. The mine is being flooded in order to stop the fire in the Kennedy mine near-by. The workings of the two mines have communicating tunnels. Ben Sanguinetti and John Canonica who were with Varrain noticed the gas and being unable to signal the surface climbed out and used the ladder to reach the 3900-ft. level where they telephoned to the surface and were hoisted up. S. M. Kelsey, superintendent, with E. Murphy and E. Sangillo descended to rescue Varrain. They found him on the 4500-ft. level and carried him to the surface where efforts to revive him failed.

Redding.—At the Uncle Sam mine near Kennett the Colma Copper Co., which started development work two months ago through the tunnel in the Uncle Sam mine, has put on three shifts. The tunnel will be a mile long and will cut the veins developed by the Mammoth at 600 ft. An important orebody is being developed in the Mammoth mine. A month ago it was reported that 100,000 tons was 'in sight'. The Keystone mine of the United States Smelting, Refining & Mining Co. is said to be showing up well under development.

IDAHO

Adair.—Four feet to the round is being made by the Montana-Idaho Copper Co. in the tunnel which has now reached a point between 5700 and 5800 ft. from the portal. A special meeting will be held in Spokane in April to vote on a proposed change in the capitalization from \$600,000 to \$2,500,000. The purpose of the increase is to provide funds for the electrification and further equipment of the mine and the erection of a concentrating plant.

Coeur d'Alene.—The Caledonia Mining Co. has declared its monthly dividend of \$26,050, according to Stanly A. Easton, president. This is at the rate of one cent per share on the issue of 2,605,000 shares. The Federal Mining & Smelting Co. has now 425 men employed at the Morning mine and is signing up new men as fast as they apply. The capacity of the plant is between 650 and 700 men. The mine

is reported to be in excellent shape and ready for record production. The orebodies on the lower levels are exceptionally good and contain less zinc than those on the higher levels. A new orebody rich in galena, said to be 12 ft. wide, is being developed on the 2000-ft. level, the deepest level being worked at present. This orebody will assay from 30 to 50 % lead with good silver content. Plans are being made to sink to the 2200-ft. level.

Lakeview.—Henry Gallan and C. G. Ferrell have taken a lease on the Conjecture and Spider groups adjoining the Weber mine. The lease carries with it an option to purchase the property for \$70,000.

MONTANA

Basin.—New development work at the Jib mine has resulted in the exposure of considerable high-grade ore. Two of the shoots are said to be 20 ft. wide, and it is estimated that 250,000 tons of ore has been exposed. Sinking of the three-compartment shaft at the Katie to a greater depth will be carried on simultaneously with the construction of a new 600-ton concentrator, according to reports. When operations are in full swing it is estimated that several hundred men will be employed at the plants of the Jib, Hope, and Katie mines, which comprise the holdings of the company. R. C. Gemmel, general manager for the Utah Copper Co., with a party of engineers and Eastern financiers visited the properties last week, presumably with a view to financing future operations.

Butte.—The Anaconda Copper Co. is still short of experienced miners. While repairing and fire-proofing some of the idle shafts, the company is producing at 75 % of the normal rate. The North Butte company produced 2,000,000 lb. of copper in February. The Butte & Superior company in January and February produced about 11,000,000 lb. of zinc and 210,000 oz. of silver. The East Butte company is reported to have cut a fine body of ore on the 1800-ft. level. The Davis-Daly company is drifting on a vein cut in the station on the 2700-ft. level, where 11 ft. of 6 % copper ore is reported. It is possible that the Silver King, west of town and south of the Gagnon, may be opened.

Neihart.—The Cascade silver mine is said to be earning \$35,000 to \$40,000 per month.

Potomac.—The Potomac Copper Co. has 2 to 6 ft. of native copper and copper glance in a fault fissure. The Scratch Gravel mine, situated at Philipsburg, shipped a car of silver ore last week that netted \$4700 and another that netted \$900.

NEVADA

Kimberley.—The sinking of the Alpha shaft an additional 400 ft., as decided upon last year, has been completed. Further diamond-drilling will, however, be done before cross-cutting to the ore-zone, since drilling to date indicates that the ore at this level is oxidized. As the upper levels of the Alpha mine contain large quantities of direct-smelting ore, there is, of course, no advantage in opening up new levels until the sulphide zone is reached. Diamond-drilling from the 1300 and 1400-ft. levels of the Alpha mine is being pushed as rapidly as possible. Three drills are now at work, and the immediate shipment of a fourth has been ordered. Work on plans for the new reduction-works is progressing.

MR. HOOVER ON THE REPORT OF THE INDUSTRIAL CONFERENCE

On March 21 Mr. Hoover made the following comment on the report issued by the Industrial Conference, of which he was acting chairman:

"The background of the Conference report is a policy of 'get together' for joint settlement, with pressure to bring it about where the parties were unwilling. The Conference considered that modern industry, as conducted in large establishments, had caused a loss of personal contact between employers and employees. It, of course, makes possible the greater production that has made our high standard of living. Direct personal contact, in the old manner of smaller units, with the sense of personal responsibility for the interest of both sides, cannot be restored.

"The Conference, therefore, believes that the just, human relationships between the employer and the employee can only be promoted by deliberate organization to bring them together. It feels that a new American basis of industrial relationships has been developing during the last two or three years in the widespread and deliberate organizations of these relations between employers and employees in many hundred establishments through the country on a democratic basis.

"The plan involves but small Government expenditure and but little extension of permanent public officials. A board of nine members at Washington, together with twelve Regional Chairmen, comprise all there is to this basic machinery. It is interesting to note that so great an authority as the Hon. William L. Mackenzie-King, former Minister of Labor of Canada, who has been largely responsible for the origin and administration of the Canadian industrial procedure, considers the plan put forward by the Conference as a constructive improvement on all others hitherto proposed.

"The report probably will not meet with the approval of the extremists on either side, but it has been approved in its broad lines by many hundreds of employees and many prominent labor leaders who have been consulted or communicated with. The Conference believes that it will appeal to those who believe in sane and sure steps to advance human relations in industry. It will be interesting if critics will read the entire document before they launch forth criticisms. It would be even more interesting if political leaders would state their agreement or disagreement with it."

RESOLUTION ADOPTED BY MONTANA SECTION OF A. I. M. & M. E. ON MARCH 5

Whereas, There is at this time a strong and wide-spread sentiment for Herbert C. Hoover for President of the United States; and

Whereas, Hoover, by his work in Europe, has shown executive and administrative abilities of the highest order, particularly fitting him for handling both the economic problems of reconstruction at home, and our relations with other nations; and

Whereas, The Montana Section of the American Institute of Mining and Metallurgical Engineers has a patriotic duty to perform at this time, not only as representing engineers, but also as a representative body of American citizens; be it therefore

Resolved, That the Montana Section, representing 217 engineers in Montana, endorses Herbert C. Hoover for President.

Committee on Resolution

Reno H. Sales, Chairman

Charles H. Clapp

Norman B. Braly

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. B. Lakenan is in San Francisco.

Herbert W. Pudan has gone to Sinaloa, Mexico.

Bond Coleman has left El Paso for Zacatecas, Mexico.

Frank L. Sizer has returned from Randsburg, California.

B. V. Barton has left Korea and is now at Malvern, Victoria.

W. C. Loughlin has returned from Sonora, Mexico, to Los Angeles.

Knox & Allen have moved their office to 160 Broadway, New York.

James W. Neill was seen on the Claremont golf-course last Wednesday.

W. E. Defty, of Phoenix, Arizona, was in San Francisco during the week.

Ben. B. Lawrence is recuperating from an accident at Augusta, Georgia.

R. C. Gemmell has returned to Salt Lake City after a trip to New York and Washington.

Augustus Locke has returned to San Francisco from New York, after a trip to Arizona.

John T. Towers, of Seattle, is operating a copper property on Kupreduof island, south-eastern Alaska.

D. C. Jackling is in New York. He visited the Ray and Chino properties in Arizona and New Mexico.

H. J. Sheafe has been put in charge of War Minerals Relief work for the U. S. Bureau of Mines, on the Pacific Coast.

David Cole of El Paso was recently in the Globe district on professional work connected with the Iron Cap Copper Co.

L. C. Hill, engineer on the staff of the Rio Tinto mine, in Spain, has been making a tour of the mines of the South-West.

F. P. Knight, president, and Roland H. Knight, secretary and treasurer of the Iron Cap Copper Co., are in the Globe district.

J. M. Sully, general manager for the Chino Copper Co., has been in New York, Boston, and Washington. He has returned to Hurley, New Mexico.

E. W. Fredell has been appointed superintendent for the Arizona Hercules Copper Co., in charge of the milling and power plants, at Hercules, Arizona.

Charles A. Mitke was in the Jerome district for several weeks recently, where he was engaged in professional work for the United Verde Extension Mining Co.

W. D. Thornton, vice-president, and L. D. Ricketts, consulting engineer for the Inspiration Con. Copper Co., are making a visit of inspection to that property.

Dale L. Pitt, formerly ore-buyer for the Tacoma smelter, has been appointed general manager of the Premier mine in the Salmon River district, British Columbia.

Hugh R. Van Wagenen, general manager for the Canadian Copper Corporation at Princeton, British Columbia, has been visiting the mines of the New Cornelia Copper Co. at Ajo.

E. C. T. Pelham, formerly district sales-manager for the Denver Rock Drill Co., with offices at El Paso, and now connected with the Denver office of the company, is in Mexico City.

Zear J. Chamberlain, one of the oldest and most valued employees of the Ludlow-Saylor Wire Co., died on March 20 at the age of 44 years. He was well known to business associates all over the country, having represented his firm for nearly 30 years.

THE METAL MARKET



METAL PRICES

San Francisco, March 30

Aluminum dust, cents per pound.....	65
Antimony, cents per pound.....	744
Copper, electrolytic, cents per pound.....	19
Lead pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$142
Platinum, 10% iridium, per ounce.....	\$162
Quicksilver, per flask of 75 lb.....	\$95
Spelter, cents per pound.....	10
Zinc dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

March 29—Copper is more active and stronger. Lead is quiet and easier. Zinc is inactive and steadier.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

		New York	London	Average week ending		
Date		cents	pence	Cents	Pence	
Mch.	23.....	129.37	75.50	Feb.	16.....132.10	85.72
"	24.....	123.50	71.50	"	23.....130.00	83.55
"	25.....	124.50	72.12	Mch.	1.....129.87	82.75
"	26.....	125.00	71.00	"	8.....130.37	81.16
"	27.....	126.00	68.12	"	15.....121.90	72.14
"	28 Sunday.....			"	22.....123.42	70.35
"	29.....	126.50	71.62	"	29.....125.81	71.64
Monthly averages						
	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12		Sept.	101.12	113.92
Apr.	95.35	101.12		Oct.	101.12	119.10
May	99.50	107.23		Nov.	101.12	127.57
June	99.50	110.50		Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date			Average week ending		
Mch. 23.....	18.50		Feb. 16.....	19.00	
" 24.....	18.50		" 23.....	19.02	
" 25.....	18.62		Mch. 1.....	18.81	
" 26.....	18.75		" 8.....	18.62	
" 27.....	18.75		" 15.....	18.37	
" 28 Sunday.....			" 22.....	18.10	
" 29.....	18.87		" 29.....	18.66	
Monthly averages					
	1918	1919	1920	1918	1919 1920
Jan.	23.50	20.43	19.25	July	26.00 20.82
Feb.	23.50	17.34	19.05	Aug.	26.00 22.51
Mch.	23.50	15.05		Sept.	26.00 22.10
Apr.	23.50	15.23		Oct.	26.00 21.68
May	23.50	15.91		Nov.	26.00 20.45
June	23.50	17.53		Dec.	26.00 18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending					
Mch. 23.....	9.00	Feb. 16..... 8.75				
" 24.....	9.00	" 23..... 8.92				
" 25.....	9.00	Mch. 1..... 9.18				
" 26.....	9.00	" 8..... 9.43				
" 27.....	8.87	" 15..... 9.50				
" 28 Sunday.....		" 22..... 9.10				
" 29.....	8.87	" 29..... 8.90				
Monthly averages						
	1918	1919	1920	1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78
Mch.	7.26	5.24		Sept.	8.05	6.02
Apr.	6.99	5.05		Oct.	8.05	6.40
May	6.88	5.04		Nov.	8.05	6.76
June	7.59	5.32		Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	
Mch.	85.00	72.50		Sept.	80.40	55.79	
Apr.	88.53	72.50		Oct.	78.82	54.82	
May	100.01	72.50		Nov.	73.67	54.17	
June	91.00	71.83		Dec.	71.52	54.94	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date			Average week ending			
Mch. 23.....		8.85	Feb. 16.....		9.08	
" 24.....		8.80	" 23.....		9.25	
" 25.....		8.70	Mch. 1.....		9.20	
" 26.....		8.75	" 8.....		8.98	
" 27.....		8.80	" 15.....		9.06	
" 28 Sunday.....			" 22.....		8.91	
" 29.....		8.80	" 29.....		8.87	
Monthly averages						
	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	6.66	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.67	6.53	Sept.	9.58	7.57
Apr.	7.04	6.49	Oct.	9.11	7.83
May	7.92	6.43	Nov.	8.75	8.12
June	7.92	6.91	Dec.	8.49	8.69

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Average week ending		Mch.		18.		85.00
Mch.	2	85.00	"	23	"	85.00	85.00
"	9	80.00	"	30	"	90.00	90.00
						95.00	95.00
Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	100.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	103.00
Mch.	112.00	72.80		Sept.	120.00	102.60	102.60
Apr.	115.00	73.12		Oct.	120.00	86.00	86.00
May	110.00	84.80		Nov.	120.00	78.00	78.00
June	112.00	94.40		Dec.	115.00	95.00	95.00

MONEY AND EXCHANGE

The reports that have lately obtained currency in London and New York as to the impending export of gold on a large scale to the United States afford many opportunities for surmise and speculation as to the future of gold. At the same time, it is both helpful and interesting to recall some features of the recent history of the metal since the producers of South and West Africa were permitted a free market for the sale of their commodity, says the 'Financial Times'.

When the first available gold under the new arrangement reached the London market last September the most adverse exchange to this country was that of New York, the dollar being then at a premium of approximately 15%, against its parity of \$4.8665 to the pound sterling. Further, the price at which gold was exchangeable for dollars was still \$20.67183 per ounce, a figure corresponding to the parity of \$4.8665 per pound sterling. It was naturally anticipated that a large proportion of the gold available from time to time would find its way to New York. In point of fact, it is doubtful if 3% of the total gold marketed in London since September last has reached the United States of America. Since the latter part of October, apart from nominal quotations when no dealings took place, the price of gold has not once been fixed at a figure at which its export to New York would have been immediately profitable on either a large or small scale.

What, then, are the factors that have contrived to negative these early anticipations? The Indian government, faced with the necessity of providing for its currency demands, has resorted to extensive purchases of gold, which have been continued until a recent date, and it may be stated that the greater portion of the 'free gold' accordingly has found its way directly to India.

Other important purchasers have been Argentina, Straits Settlements, South Africa, Spain, Switzerland, and, in a lesser degree, Holland and France. Since the recent adoption by the Secretary of State of the report on Indian currency the India Council seems to have retired from the field for the time being, the premium on gold in the bazaars having fallen considerably, and in the absence of this most important competitor it is considered doubtful whether, apart from the United States, other buyers will entirely absorb the available supplies. With exchanges at their present level the potential destinations of gold are the United States, Argentina, Japan, India, Spain, Straits Settlements, and Switzerland.

In a lesser degree some other Continental countries are both possible and probable buyers, but not as exchange propositions. As the situation stands at present exporters to Argentina are in a position to offer better terms than other competitors, buying gold as a cover against the sale of exchange, but it is questionable whether purchases for this quarter are capable of absorbing an average of 180,000 oz. per week, while the resultant offering of exchange on Argentina would tend to reduce the value of the gold peso in sterling to a level corresponding to that of the United States dollar. So far 'free gold' has not been engaged for shipment to Japan. Competition from this quarter, if it materializes, is not likely to be very serious, while the remarks in reference to Argentina importations apply with even greater force to Japan. At the same time the exportation to the United States will doubtless take place.

Foreign quotations on March 30 are as follows:

Sterling, dollars:	Cable	3.87 1/2
	Demand	3.86 1/2
Francs, cents:	Cable	6.74
	Demand	6.73
Lire, cents:	Demand	4.88
Marks, cents		1.45

Eastern Metal Market

New York, March 24.

Only moderate activity characterizes most of the non-ferrous markets, prices in some still being erratic.

After receding to what appears to be a low level on this movement, prices for copper are recovering and demand is better.

There is a much more active interest in tin by regular consumers and buying has appeared in volume at fluctuating prices.

Lead has eased off in price and requirements are less urgent.

Zinc prices still float up and down daily with fair buying at the low level.

Antimony is quiet and strong.

IRON AND STEEL

The Steel Corporation continues to sell for second-half delivery at the prices of March 21, 1919. Independent producers still get higher prices in all lines.

In view of all the handicaps, production continues so large that the accepted estimates of capacity are being revised upward. Railroad buying has been disappointing, apart from the first show of activity in the few days following the return of the lines. Fresh shipbuilding enterprises still appear. Demand for structural material has dwindled. Occasional cancellations, now somewhat emphasized, are not necessarily different from those seen at other times. Sales aggregating about 12,000 tons of steel-making and foundry pig-iron have been made for export and further sales are pending.

COPPER

Up to the end of last week the copper marked declined until electrolytic reached a level of 18c., New York, for deliveries up to July 1. This appeared to attract some consumers and some buying is reported to have been put through. Since then quotations have advanced until today the same brand is held at 18.50 to 18.75c., New York, for the same positions. Lake copper is now around 18.87½ to 19c., New York. More interest is manifested by consumers and the tone of the entire market is stronger and brighter.

TIN

Consumers have at last become interested and the market reveals a different aspect. The speculative phase, so long dominant, is disappearing. Last week there was again a fair business between dealers and on March 18 there appeared a heavy inquiry from consumers who exhibited a strong desire to buy. This was partly due to a heavy drop in the London market of £23 to £24 per ton on that day—down to £335 for spot Straits—as compared with a high of £418 per ton a few weeks ago. Sellers here, however, became reluctant to part with their metal, scenting the market at its low point, which has been justified by later developments. Much more tin could have been sold on that day had there been the sellers. As it was, about 300 to 400 tons changed hands for all positions and at prices well above import cost, which is termed a feature of present conditions. On March 18 the price spread was wide, spot Straits selling as low as 58.25c., New York, and as high as 59.62½c. On March 22, the price spread was equally wide, spot Straits selling at 61.30 to 61.75c., New York, with futures sold at 63c. On March 23 there was a good inquiry, partly influenced by a break of £9 in the London market where spot Straits was quoted at £345 per ton and futures at £348. Yesterday spot Straits was quoted at 60.75c., New York. A fair business resulted. Arrivals thus far this month have been 2605 tons with the quantity afloat reported as 3585

tons. The exportation of 50 tons to Hamburg, Germany, is of interest.

LEAD

With prices strong and the tendency apparently higher, the market last week was somewhat startled by offerings by a leading independent producer of lead at 9c., New York. Partly as a result of this and partly because of the more normal conditions of transportation, releasing some of the large quantities of lead in transit, the market is easier and quiet. For early delivery the metal is obtainable at 8.75c., St. Louis, or 9c., New York, from outside sellers, with the leading interest at 9c., St. Louis, or 9.25c., New York.

ZINC

The intimate relation, sentimentally at least, between the American market and the London continues to be the feature. The foreign market has continued its speculative trend and is very erratic, up one day and down the next. As a consequence quotations here for prime Western have fluctuated in the last week from 8.50 to 8.87½c., St. Louis, for delivery to July 1. At the lower prices a fair domestic business has been done each time. Yesterday quotations were 8.50c., St. Louis, or 8.85c., New York, with the market quiet. Inquiry is moderate and so is the tonnage changing hands. Export business at present is dull. Leading producers are not anxious to sell on the dips and are comfortably situated.

ANTIMONY

For the better grades of antimony quotations are firm at 11.50 to 11.75c., New York, duty paid, for wholesale lots for early delivery. The market is quiet.

ALUMINUM

Virgin metal, 98 to 99% pure, in wholesale lots for early delivery, is quoted at 31c., New York, and in the outside market and at 33c., by the leading producers.

ORES

Tungsten: The tariff bill continues the centre of attraction, but there are some who still insist it will never become a law. The Senate Finance committee has reported the bill favorably but with certain changes. The tariff on ore and concentrates is to be \$9 and on ferro-tungsten, tungsten powder, etc., 0.9c. per pound of material for each per cent of tungsten contained, with the present advalorem of 15% retained; on high-speed and alloy steels 35% advalorem is to be retained, making a total of 50% advalorem. Consideration of this is expected in two weeks.

Ferro-tungsten is quoted at 80 to 90c. per pound of contained tungsten.

Molybdenum: The market is inactive with prices nominal at 75c. per pound of MoS, in regular concentrates.

Manganese: Some Indian ore as well as Chilean and Java ore of good grade probably will be soon available. The last important sale of foreign ore was 15,000 to 20,000 tons of Indian ore to a large American producer of ferro-manganese. Prices range from 65 to 80c. per unit, depending on the ore, the quantity, and the delivery.

Manganese-Iron Alloys: Inquiries for early delivery ferro-manganese are fairly numerous, greater in fact than the supply of the alloy. While no spot sales were reported during the last week, it is freely admitted that almost any price from \$230, delivered, up, could be obtained. The most significant information of the week is the fact that British supplies of manganese ore are not being received as calculated and that as a consequence one British representative here is advised that deliveries of alloy on contract to American consumers will be delayed. This may have a decided influence on the course of the market here. Spiegeleisen is strong at \$60, furnace, with foreign inquiries predominant.

Company Reports

RAY CONSOLIDATED COPPER CO.

Report for the quarter ending December 31, 1919.

Property: mine at Ray, and concentrator at Hayden, Arizona.

Operating Officials: William S. Boyd, manager; Charles A. Smith, mine superintendent; William T. McDonald, mill superintendent.

Financial Statement: net operating profit, \$641,378; miscellaneous income, \$5848; total, \$647,226 as compared with \$932,147 for the preceding quarter.

Dividends: \$788,589.50; total to date, \$23,835,430.

Development: current underground development for the quarter totaled 7012 feet.

Production: 11,614,647 lb. of copper was produced from 397,100 tons of ore averaging 1.813% copper; milling cost was \$1.42 as compared with \$1.33 for the previous quarter. The average cost of copper was 16.57c. exclusive of credit for gold and silver. Operations during the quarter were conducted at one-half capacity.

THE TEMISKAMING MINING CO., LTD.

Report for the year ending December 31, 1919.

Property: mines and claims in North Cobalt and Porcupine districts.

Operating Officials: Gordon F. Dickson, general manager; J. W. Moffitt, mine superintendent.

Financial Statement: proceeds from ore sales, \$230,838; estimated ore on hand December 31, 1919, \$92,035; ore on hand December 31, 1918, \$27,621; net earnings, \$295,253; operating expense, \$263,253; net profit, \$31,996; miscellaneous income, \$66,072.

Dividends: dividend No. 25, \$100,000; total dividends to date, \$2,225,000.

Development: 2283 ft. of development work was performed; rich ore was discovered in the southern extension of the vein system in the Gans area.

Production: 15,899 tons of ore milled produced 243,037 oz. of silver with an extraction of 88.6%; total cost of mining and milling, \$11.71 per ton.

DAVIS-DALY COPPER COMPANY

Report for the quarter ending December 31, 1919.

Property: mine at Butte, Montana.

Operating Officials: James L. Bruce, general manager; William Frazier, mine superintendent.

Financial Statement: returns on ore, \$477,455; miscellaneous revenue, \$33,037; total expense, \$339,238; cash and quick assets on December 31, \$569,571.

Dividends: \$300,000 on December 20; total to date, \$750,000.

Development: 1825 ft. of this character of work was done during the quarter. Indications on the 2700-ft. level are favorable.

Production: 25,989 tons of ore hoisted produced 3,504,391 lb. of copper and 145,616 oz. of silver; the ore shipped averaged 6.72% copper and 5.59 oz. of silver per ton. Improvements in surface equipment are under way.

VINDICATOR CONSOLIDATED GOLD MINING CO.

Report for the year ending December 31, 1919.

Property: mines in the Cripple Creek district and a controlling interest in the Ferro Alloy Company; also the La Bella mill.

Operating Officials: George A. Stahl, general manager; W. E. Ryan, general superintendent; A. R. Minner, mill superintendent.

Financial Statement: proceeds of ore sales and royalties \$681,411; miscellaneous income, \$10,631; mine and mill

operation cost \$600,561; leaving an operating profit of \$91,481; profit from Ferro Alloy operations, \$7478; total operating profit, \$98,959. Deducted for depreciation and depletion, \$115,824, this being an excess of \$16,865 over the operating profits. Quick assets on December 31, 1919, \$565,858.

Dividends: during 1919 amounted to \$60,000, making a total to date of \$3,832,500.

Development: 7622 ft. of development work was done during 1919, including 1200 ft. of diamond-drill work. Prospects on the 1500 and 1900-ft. levels are good. Ore-reserves on December 31 are estimated at 46,440 tons.

Production: during the year 1919, 143,400 tons of crude ore was hoisted on company account through both shafts, from which was produced 19,922 tons of shipping product, with a gross value of \$718,137; the marketing charges on which were \$129,251, and the net returns \$588,885. There were hoisted on lessees' account \$55,648 crude tons; and shipments from this source totaled 20,772 tons, with a gross value of \$291,065, marketing charges on which were \$104,742, leaving a net value of \$186,323. The company's royalties on lessees shipments amounted to \$92,525.

THE PORTLAND GOLD MINING CO.

Report for the year ending December 31, 1919.

Property: Portland and Independence mines and the Independence mill in the Cripple Creek district, and the Portland mill at Colorado Springs.

Operating Officials: George M. Taylor, general manager; Fred Jones, mining engineer; Thomas B. Crowe and J. M. Tippet, metallurgical engineers.

Financial Statement: gross value of ore mined and shipped, \$1,272,720; proceeds from Independence mill, \$513,877; miscellaneous revenue, \$6293; cost of mining and milling, \$1,562,600; net profit from operation, \$230,290.

Dividends: \$240,000 during 1919; total to date, \$11,497,080.

Development: the mines have been opened a depth of 2300 ft., where a station and pumping equipment has been completed. Good ore is being blocked out on the 20th and 21st levels.

Production: 373,192 tons of ore was produced during 1919.

LAKE SHORE MINES LIMITED

Report for the year ending November 30, 1919.

Property: gold mine and mill in the Kirkland Lake district.

Operating Official: R. C. Coffey, mine manager.

Financial Statement: bullion production, \$294,514; miscellaneous income, \$13,017; total expense, \$209,258; provision for exhaustion, \$60,000; net profit, \$38,273.

Dividends: \$100,000; total to date, \$200,000.

Development: a total of 1864 ft. of drifts and cross-cuts on the 200 and 400-ft. levels was performed.

Production: the mill was shut-down for four months on account of labor troubles, being re-started in October; 11,907 tons was milled with a recovery of \$24.67 per ton.

BUTTE & SUPERIOR MINING CO.

Report for the quarter ending December 31, 1919.

Property: mine and mill at Butte, Montana.

Operating Officials: Charles Bocking, general manager; E. V. Daveler, general superintendent; Angus McLeod, mine superintendent.

Financial Statement: operating costs, taxes, etc., for the quarter, \$1,182,581; profits, \$566,984.

Dividends: none during 1919; total to date, \$16,940,258.

Development: development work included 3669 ft. of drifting, 1677 ft. of cross-cutting, and 967 ft. of raises; no shaft-sinking was performed during the quarter.

Production: 125,931 tons was mined and milled, having

an average zinc content of 14.916% and silver content of 5.914 oz.; direct mining cost was \$6.125, direct milling cost, \$2.616, both of which figures showed an improvement over the previous quarter. Milling operations in which more than 1% of oil was used in flotation produced concentrate averaging 54.74% zinc and 19.537 oz. silver.

ALASKA GOLD MINES CO.

Report for the quarter ending December 31, 1919.

Property: control of the Alaska Gastineau Mining Co. owning mines, concentrator, and hydro-electric power plant at Juneau, Alaska.

Operating Officials: George T. Jackson, manager; D. J. Argall, mine superintendent.

Financial Statement: gross value of bullion and concentrate produced \$415,352; total operating expense, \$503,953; miscellaneous income, \$4028; operating loss, \$84,572.

Dividends: none to date.

Development: 738 ft. of development consisted of driving manway-raises and bulldozing-drifts preparatory to opening new stopes.

Production: tons milled, 692,534; value per ton, \$0.75; value of gold recovered, 60c. per ton.

THE NATOMAS COMPANY OF CALIFORNIA

Report for the year ending December 31, 1919.

Property: gold-dredging land in Sacramento and Butte counties, California.

Financial Statement: gross returns from dredging, \$1,775,124; cost, \$1,313,640; net returns, \$461,484; other income, \$570,180; expense, including bond interest, \$864,117; net operating profit, \$167,548; current assets, \$1,036,335.

Production: 11 gold-dredges were operated during the year; 20,485,000 cu. yd. of gravel containing 8.66c. per cubic yard was handled at a cost of 6.41c., leaving a net profit of 2.25c. per cubic yard. Some income was derived from dredging land not owned by the company.

THE VICTORIA COPPER MINING CO.

Report for the year ending December 31, 1919.

Property: mines and mill in Ontonagon county, Michigan.

Operating Officials: George Hooper, superintendent; Charles D. Hooper, mill and power superintendent.

Financial Statement: proceeds from copper sold, \$39,152; inventoried value of copper on hand, \$208,537; miscellaneous income, \$14,907; total expense, \$299,455; excess of expenditures over receipts, \$36,857; cash assets, \$262,384.

Dividends: no dividends during 1919.

Development: No. 2 shaft was finished to the 28th level; favorable developments are noted on the 23rd, 24th, and 27th levels from this shaft, where 1908 ft. of development was performed during 1919.

Production: 105,600 tons of ore was hoisted, of which 89,206 tons was stamped. The yield of refined copper was 1,245,000 lb., of which 330,000 lb. is the estimated production from ore not yet smelted. The yield was 14 lb. of copper per ton of ore stamped.

BINGHAM MINES COMPANY

Report for the year ending December 31, 1919.

Property: the Dalton & Lark and Commercial mines at Lark, Utah; control of the Eagle & Blue Bell Mining Co. and the Yosemite Mines Co.

Operating Official: Joseph Hyland, superintendent.

Financial Statement: net receipts from ore shipments, \$138,653; royalties and rentals, \$42,792; gross earnings, \$181,446; operating expense, \$111,972; mine development, \$26,405; income from dividends, \$41,928; net gain for year, \$80,306; surplus, December 31, 1919, \$261,231.

Dividends: \$112,500 during 1919; total to date, \$600,000.

Development: new work at Lark, totaling 1358 ft. Prep-

arations have been made to explore the Lark vein below the Mascot tunnel. Favorable development on the Brooklyn was accomplished. At Tintic, development was curtailed on account of the unfavorable lead market, the most important work being done on the south end of the 1350-ft. level.

Production: 26,561 tons of ore containing 2049 oz. of gold, 194,006 oz. of silver, 1,939,737 lb. of lead, and 636,515 lb. of copper from the Bingham mines. At the Eagle & Blue Bell mine 23,003 tons of ore containing 1642 oz. of gold, 389,536 oz. of silver, 55,060,000 lb. of lead, and 467,364 lb. of copper was produced.

HOLLINGER CONSOLIDATED GOLD MINES, LIMITED

Report for the year ending December 31, 1919.

Property: mine and mill at Porcupine, Ontario.

Operating Official: A. F. Brigham, general manager.

Financial Statement: bullion produced, \$6,722,267; miscellaneous income, \$340,832; general charges, \$303,563; mining, \$2,053,210; milling, \$865,844; total, \$3,222,617; operating profit, \$3,840,482; taxes, depreciation, etc., \$1,519,192; net quick assets, \$3,602,554.

Dividends: during 1919, \$1,722,000; total to date, \$11,146,000.

Development: total sinking, drifting, cross-cutting, and raising, 22,643 ft.; diamond-drilling, 37,868 ft.; underground ore-reserves on December 31 estimated at 4,178,000 tons with a value of \$37,817,000, in addition to \$2,000,000 estimated from surface outcrops.

Production: 711,882 tons was milled; average value per ton, \$9.73; net value recovered, \$6,722,267; average tons per day, 1950; value of tailing, 33c. per ton; total mining charges, \$2.884 per ton; total milling charges, \$1.216 per ton.

TECK HUGHES GOLD MINES, LIMITED

Report for the year ending August 31, 1919.

Property: mine and mill in Kirkland Lake district, Ontario.

Operating Official: E. L. H. Forbes, general superintendent.

Financial Statement: bullion production, \$149,875; operating expense, \$162,661; miscellaneous expense, \$67,756; operating deficit, \$80,542; quick assets, \$58,580.

Dividends: none to date.

Development: 1441 ft. of development work opened new ore on the 2nd, 4th, and 5th levels. Reserves are estimated at 26,000 tons, averaging \$10. This is more than was known to be available at the corresponding date in 1918.

Production: 16,907 tons of ore with an average gross value of \$10.27 per ton produced \$149,875. Operating conditions were unfavorable during the year.

NEVADA CONSOLIDATED COPPER CO.

Report for the quarter ending December 31, 1919.

Property: mines, mill, and smelter near Ely, White Pine county, Nevada.

Operating Officials: C. B. Lakenan, general manager; Robert Marsh, Jr., mine superintendent; George C. Riser, mill superintendent; R. E. H. Pomeroy, smelter superintendent.

Financial Statement: operating profit, \$403,331; other income, \$283,958; net gain, \$687,290.

Dividends: \$749,796; total to date, \$45,269,024.

Development: of the tonnage milled, 62% was supplied from the pit and 38% from the underground workings of the Ruth mine.

Production: 592,953 dry tons, averaging 1.55% copper, was milled, in addition to 57,451 dry tons of custom ore. The cost of production, including depreciation, was 18.64c. per pound of copper. Precious-metal recovery amounted to 2.51c. per pound of copper.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

AERO BRAND CYANIDE

Aero Brand cyanide, grade X, made from the air at Niagara Falls, is the cheapest form of cyanide on the market. In its manufacture two low-costing raw materials, cyanamid (air-nitrogen) and common salt, are fused in an electric-furnace. The molten product is then run over a special cooling device and into drums, ready for shipment. The low production cost, plus a nominal selling expense and moderate profit, permits of a selling price much below the quotations for any other grade of cyanide. Aero Brand cyanide at present contains upward of 36% sodium cyanide, equivalent to approximately 48% potassium cyanide. The other components are: about 1% calcium cyanamid, about 5% of insoluble matter, 15% of caustic lime, and 43% of chlorides

ture in the air may cause decomposition and consequent escape of cyanide fumes. It is not advisable to grind the flaked cyanide in a dry form on account of this probable loss. The flaky nature renders its solution in water extremely easy and there is no need of further grinding in order to obtain solution. Aero Brand cyanide, pound for pound of contained cyanide, is equal in efficiency to the 96 to 98% grade. The soluble salts present other than cyanide, owing to their coagulating effect on the slimes, materially assist the settling operations and reduce the time required for clarification and filtration. The lime present helps to maintain the protective alkalinity of the solutions. The slight amount of soluble sulphides give no trouble in practice, as the air-agitation used in the leaching tanks quickly removes



Plant of the American Cyanamid Co. at Niagara Falls

of lime and sodium. Pound for pound of contained cyanide Aero brand is equal in efficiency, for all purposes, to cyanide in any other form or grade.

The first successful experiments on the fixation of air-nitrogen were begun about 25 years ago, with the object of producing cheap cyanide. Instead of cyanide, however, another chemical (cyanamid) was obtained. This proved so useful as a fertilizer that the cyanide process was temporarily abandoned. In 1916 the American Cyanamid Co., whose production of air-nitrogen products at Niagara Falls had reached an annual value of over \$6,000,000, undertook to convert cyanamid to cyanide. The manufacture of Aero Brand cyanide was begun January 1, 1917. Consumption in the first year of its manufacture reached a total of 2,310,420 lb. of sodium cyanide. In 1918 consumption was increased to 2,577,920 lb. In 1919 the consumption exceeded 3,500,000 lb. Additional equipment is now being installed for increasing the production, to keep pace with the demand from both the mining and chemical fields.

Aero Brand cyanide is marketed in the form of small brittle flakes of a grayish-black color, about $\frac{1}{8}$ in. thick and from $\frac{1}{16}$ to $\frac{1}{4}$ in. diameter. On account of its flaky form, and consequently the large surface exposed to the air, it should not be allowed to stand in open containers longer than necessary before discharging into the solution tanks. The mois-

ture in the air may cause decomposition and consequent escape of cyanide fumes. It is not advisable to grind the flaked cyanide in a dry form on account of this probable loss. The flaky nature renders its solution in water extremely easy and there is no need of further grinding in order to obtain solution. Aero Brand cyanide, pound for pound of contained cyanide, is equal in efficiency to the 96 to 98% grade. The soluble salts present other than cyanide, owing to their coagulating effect on the slimes, materially assist the settling operations and reduce the time required for clarification and filtration. The lime present helps to maintain the protective alkalinity of the solutions. The slight amount of soluble sulphides give no trouble in practice, as the air-agitation used in the leaching tanks quickly removes

them. The insolubles have no precipitating or other deleterious effect in the leaching operation, as has been demonstrated by practice covering three years operation. The consumption of zinc is the same with Aero Brand cyanide as with high-test cyanide. It is ordinarily introduced, like other grades, directly into the agitation tanks. Where grinding ore in solutions is practised, the cyanide solution behaves in the same manner as with any other grade of cyanide. The making up of very concentrated solutions of Aero Brand cyanide is not recommended. The necessity of using sufficient water to dissolve all the solubles usually operates against this practice.

Aero Brand cyanide has been successfully used in the treatment of many varieties of ore. Experience has shown it can be used in the same manner as the 96 to 98% grade, with the exception of a few special cases requiring unusual treatment.

MOLYBDENUM

Molybdenum owes its name to the word 'Molybdaena', under which title most minerals resembling lead in appearance were known in the eighteenth century. It is a metallic element reduced chiefly from the sulphide molybdenite (MoS_2), which is a mineral very similar in appearance to

graphite. Molybdenite and other molybdenum-bearing ores are found widely distributed throughout the world.

The metal (Mo) resembles platinum in general physical appearance, although it is darker and possesses a peculiar lustre. Its atomic weight is 96, its specific gravity about 9, its specific heat about 0.07, and it melts at about 2550°C. Despite the very high melting point of metallic molybdenum, it alloys readily with iron, the ferro-molybdenum having a melting point of approximately 1470°C. It resists most acids and chemicals to a marked degree.

The molybdenum-bearing ores are found widely distributed; the metal up to a few years ago was classed as semi-rare or semi-precious, as no deposits of real commercial magnitude had been discovered. A few years ago the Climax Molybdenum Co. acquired possession of a deposit of molybdenum sulphide (molybdenite— MoS_2) at Climax, Colorado, north-east of Leadville. This orebody, by far the largest known, is of such extent and magnitude as to make molybdenum commercially available on a scale sufficient to meet all requirements of the steel trade.

The flotation mill, at Climax, to treat the crude ore, has at present a capacity of 1000 tons per day, and at this rate of production, the ore-reserves already developed—in this one deposit alone—ensure steady operation for more than thirty years. The entire orebody has not been developed as yet. The ore is broken, delivered to the mill by aerial tramway, ground, and concentrated by oil-flotation to from 60 to 70% MoS_2 . The concentrates are then converted into ferro-molybdenum, or calcium molybdate, in either of which forms the metal is readily introduced into the steel.

The Climax Molybdenum Co. is the largest producer of molybdenum in the world and is in a position to supply the trade with any commercial quantities over any period of time desired. Climax ferro-molybdenum is produced in two grades, both containing 50 to 60% metallic molybdenum, the 'Regular' grade is guaranteed to contain a maximum of 2% carbon and the 'Special' 0.5%. The former, as the name implies, is generally used. Both are characterized by a low percentage of impurities and great uniformity. Climax calcium molybdate contains about 42% metallic molybdenum, the balance being lime. There is no free carbon or sulphur.

COMMERCIAL PARAGRAPHS

The Roessler & Hasslacher Chemical Co. has moved its main office to more commodious quarters at 709-717 Sixth Ave. The company's postoffice box number will be 119 Times Square Station, New York City.

The Chicago Pneumatic Tool Co. announces that the address of its general offices will hereafter be Chicago Pneumatic building, 6 East 44th street, New York. The company maintains branches at 26 of the larger cities throughout the United States.

The Denver Fire Clay Co. has issued bulletin No. 201 dealing with the company's crushing and pulverizing devices. The equipment which the company lists includes bucking-boards and mullers, grinders, samplers, mortars, and sieves. The bulletin will be mailed on request; either the Salt Lake City or Denver branches being supplied with a stock.

At the annual meeting of Midwest Forge & Steel Co., of East St. Louis, the following new officers were elected: J. W. Eschenbrenner, president and treasurer; C. T. Coates, vice-president and general manager; E. A. Eschenbrenner, secretary. The company was established in 1885, and for the past five years has been specializing in cement-mill and mine forgings, particularly grinding-plates and steel-balls.

The Jackson Compressor Co., of Denver, has issued Bulletin No. 3, describing its high-speed rotary air-compressors. The company is convinced that the rotary machine is the ideal compressor. The principal advantages are a saving

of 75% in floor space and weight as compared with the reciprocating machine; reduction in power resulting from a minimum of moving parts; and the use of the highest type of anti-friction bearings. These features are all emphasized in the machines of greater capacity. The bulletin is available to those interested.

'Smooth-On Home Repairs' is the title of a valuable booklet just published by the Smooth-On Manufacturing Co. In this book has been explained just how to repair leaks in boilers, stove-pipes, radiators, furnaces, tanks, and the many other household fixtures that need attention from time to time. There are from 30 to 40 different kinds of repairs with the remedy illustrated and explained. The use of Smooth-On in automobile repairs receives attention also in this book. Cracked water-jackets, leaky radiators, and scored cylinders are all taken up and their repairs explained.

The A. Lietz Co., 61 Post St., San Francisco, manufacturers of surveying instruments and dealers in field equipment for the engineer, are rendering a commendable service in aiding unemployed members of the profession to find positions. Many of the large corporations are availing themselves of this service by calling upon this company for field help. Transit-men, plane-table operators, draftsmen, and also rodmen and chain-men can be secured through them most advantageously and quickly. No charge or fee is exacted for this service, it being the aim of the company to establish a spirit of good-will among those benefited.

The Barber-Greene Co. manufacturer of belt-conveyors and self-feeding bucket-loaders and other equipment for handling material, announces the following organization of its sales force. R. E. Foulke, 404 3rd National Bank Bdg., St. Louis; J. A. Gurney, 605-606 Arrott Bdg., Pittsburgh; F. S. Sawyer, 1010 Penn Square Bdg., Philadelphia; and W. T. MacDonald, 305 Merchants Bank Bdg., Indianapolis. These are direct Barber-Greene branches and the representatives are experienced engineers, well qualified to furnish the best service and engineering advice to individuals and firms having material-handling problems.

The Oxweld Acetylene Co., of Newark and Chicago, has recently extended its manufacture of oxy-acetylene apparatus and equipment to include 'E'v'ready' welding and cutting outfits. This is a new name in the oxy-acetylene field, but the apparatus is not new, excepting for certain refinements of design. It has been used extensively in the metal-working trades for several years under the name of 'Prest-O-Lite' apparatus. The new name was adopted by the Oxweld company to suggest the ready convenience, adaptability, and general-purpose uses of the equipment. The apparatus is designed to use exclusively with compressed acetylene in cylinders, thus providing the welder and cutter in a compact and complete portable outfit.

The Wheeler Condenser & Engineering Co. announces the publication of the 1920 edition of its popular booklet 'Steam Tables for Condenser Work'. This is the fifth edition. Every engineer who deals with the condensation or evaporation of steam should have one of these handy tables. The pressures below atmosphere have been especially calculated for this book. It gives the properties of saturated steam from 29.8 in. vacuum to atmospheric pressure in increments of tenths of an inch. The vacuum in inches of mercury is referred to a 30-in. barometer. This method is of course superior to the old method of giving absolute pressure in pounds per square inch, since it is customary to read vacuum in inches of mercury. A complete table is also given of the properties of saturated steam above atmospheric pressure. The book tells how to make measurements by means of the mercury column and barometer. It gives constants and tables for making corrections. It is a handy book and of such size that it can be carried around in the vest pocket.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, APRIL 10, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	515

MR. HOOVER WILL ACCEPT NOMINATION.....	517
--	-----

Two telegrams to Messrs. Warren Gregory and Ralph Merritt. The real issue regarding the League. The "insularity we do not possess". Deceit of irresponsible newspapers. New York 'Times' misquoted. The non-existence of a Hoover 'machine'. A genuine popular call. The perpetually indignant Mr. Johnson.

INDUSTRIAL RELATIONS	517
----------------------------	-----

The present inefficiency. The wage-earners' point of view. Welfare work. The square deal. Attitude of distrust prevails among miners. Reasons for it. Schemes for paying miners. Article by Mr. A. K. Knickerbocker. Contract system in Minnesota mines. Mutual trust and fairness needed.

DISCUSSION

THE COMBINATION METHOD OF MINE SAMPLING

By Fred H. Dakin..... 519
Reference to Morton Webber's article. The term 'mill-test' should be discarded as misleading.

THE METALLURGY OF COMPLEX LOW-GRADE ORES

By C. S. Vadner..... 519
Sulphurous-acid leaching of copper. Hydro-metallurgy of the future. Manufacture of sulphuric acid. Field for sulphurous gases.

CHLORIDIZING PROCESSES

By Harai R. Layng..... 520
The importance of rapid heating. The question of rabbling. Unnecessary under many conditions.

ARTICLES

THE BUNKER HILL ENTERPRISE—VIII

By T. A. Rickard..... 521
Operations of the present mill. The crushing department. Flow-sheets of coarse and fine concentrating sections. The flotation department. Re-

modeling of the Old South mill. Esperanza classifier. Tailing pump-plant. Comparison of results in 1909 and 1919. Presence of siderite complicates the treatment.

ASBESTOS, A CANADIAN SPECIALTY

By F. C. C. Lynch..... 531
Deposits in Quebec. How asbestos occurs. Its quality. History of production. Methods of mining. Manufactures of asbestos.

CAR-LOADING GRATING

By William S. Evans..... 534
Description of a device in use at the smelter of the Tennessee Copper Co. for loading 'skulls' into standard railway cars.

OPERATIONS OF THE NEVADA WONDER MINING COMPANY DURING FOUR YEARS OF WAR

By E. E. Carpenter..... 537
Statistics on cost of producing silver. Grade of ore gradually diminished. Only the increased price of silver allowed profitable exploitation.

HANGING-WALL SUPPORT ON THE FAR EAST RAND

By L. W. Macer..... 539
Problem is dissimilar from that of a colliery roof. Reason for this difference. An improved method. The 'Panel system'. Use of waste material.

NOTES

CONCRETE MINE-BULKHEAD	536
------------------------------	-----

PLATINUM IN BRITISH COLUMBIA	536
------------------------------------	-----

MAGNESIA CEMENT TO PROTECT MINE-TIMBERS	
By W. C. Phalen.....	538

DEPARTMENTS

REVIEW OF MINING.....	541
-----------------------	-----

THE MINING SUMMARY.....	547
-------------------------	-----

MR. HOOVER WILL ACCEPT NOMINATION.....	549
--	-----

PERSONAL	550
----------------	-----

THE METAL MARKET.....	551
-----------------------	-----

EASTERN METAL MARKET.....	552
---------------------------	-----

COMPANY REPORTS	553
-----------------------	-----

BOOK REVIEWS	554
--------------------	-----

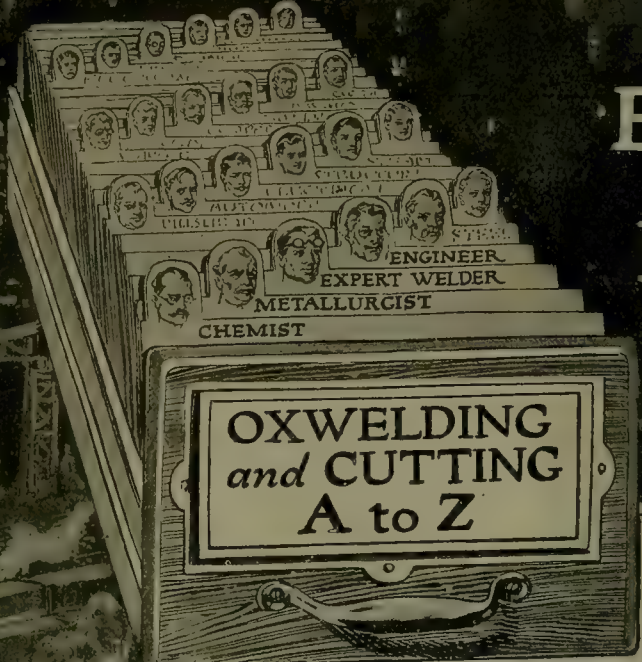
INDUSTRIAL PROGRESS	555
---------------------------	-----

Established May 24, 1880, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.

Our Experience at Your Fingertips



**OXWELDING
and CUTTING
A to Z**

OXWELD Experts—Welders, engineers, metallurgists—are ready to apply to *your* problems the great fund of Oxweld knowledge gathered the world over.

In fostering and developing the arts of welding and cutting from their inception, Oxweld has accumulated, and is daily increasing, a tremendous store of practical information on every phase of a great industry.

In more than 50 large cities there are Oxweld Sales Service Centers ready to send experts to *your* plant to help solve *your* production problems.

Write, wire or phone to any of the addresses below for immediate attention from the nearest Service Center.

OXWELD ACETYLENE COMPANY

Newark, N. J.

Chicago

Los Angeles

World's Largest Maker of Equipment for Oxwelding and Cutting Metals

O-513



T. A. RICKARD, . . . Editor

IT is announced that the Scott patents, more particularly No. 1,246,665, have been acquired by the Minerals Separation North American Corporation. These patents cover the use of oil-vapor in the concentration of ores by flotation. We published the text of the principal patent in our issue of December 22, 1917. The patentee, Mr. Walter A. Scott, was formerly a member of the firm of Sheridan, Jones, Sheridan & Smith, of Chicago, counsel for defendants in the several flotation lawsuits; he retired from the firm about two years ago. Since then Mr. Thomas F. Sheridan has been chief counsel. Rights to the use of the Scott patents were secured by the Jackling copper companies three years ago, so that this deal with Minerals Separation will not affect these companies.

VARIOUS bills affecting the mining industry are now before Congress. The Senate Committee on Finance has reported favorably on the zinc and tungsten tariff bills, but it remains improbable that this special legislation will be enacted. A tariff of \$9 per unit for three years is proposed on tungsten ores and concentrates imported into this country. On high-speed tool-steel and other alloys containing tungsten a duty of 35% ad valorem is proposed. Mr. Louis T. McFadden, of Pennsylvania, has introduced a bill, suggested by the American Bankers Association, "for protecting the gold reserve of the United States from industrial depletion" by imposing an excise duty of \$10 per ounce on the sale of all articles containing gold and on all gold used for other than monetary purposes, thereby creating a fund from which the producer is to receive \$10 for every newly-produced ounce of gold. Jewelers and other consumers may still buy gold at \$20.67 per ounce, the tax being, not upon the bullion, but upon the manufactured article.

INSCRUTABLE indeed are the ways of legislators.

Witness the case of H. R. 12,976, entitled, "A Bill, to increase the revenue of the Government of the United States and to conserve the supply of print and other paper by imposing a tax on advertisers", introduced by one Mr. Thompson and referred to the Ways and Means Committee. This bill proposes to accomplish these praiseworthy objects by the imposition of a 10% ad valorem tax on advertising in periodicals having a circulation of 5000 or more, and 15% for other advertising. Of course, there is the usual exception in favor of farmers and their implements, without which no present-day piece of legisla-

tion would be complete. How simple it is. The Government needs the money, and, in order to obtain money from its citizens, must perforce aid and abet them in all lawful means of earning money in order that they may, in turn, pay it to the Government in the form of taxes. Since, in order that commerce may be profitable, sales must be effected, and, since advertising is generally conceded by intelligent people as being the most prolific producer of sales, Mr. Thompson would "increase the revenue of the Government" by increasing the cost of advertising, thus decreasing its use and thereby, in turn, reduce sales, reduce profits, lower the revenue received from income-taxes, and increase the cost of living. Hurrah for the amateur economist!

STATISTICAL information concerning the stocks of copper on hand in Europe are given by Mr. John D. Ryan, president of the Copper Export Association, an organization formed a little more than a year ago to facilitate and control the selling of copper abroad. According to Mr. Ryan a year ago the European stocks, excluding those of the so-called Central Empires and Russia, aggregated 545 million pounds of new copper and 385 million pounds of copper in scrap. Thus the total stocks were 930 million pounds. The production during the year was 1800 million pounds through refineries in the United States and 450 million pounds through refineries elsewhere. To this must be added 100 million pounds purchased by "producers", meaning selling-agencies presumably, from the surplus held by our Government, and the copper contents of government stocks of scrap in the hands of manufacturers, this amounting to 150 million pounds, so that the grand total of European stocks, world's production, and stocks acquired from our Government, was 3430 million pounds. From this must be deducted an increase in American refinery stocks amounting to 240 million pounds and the estimated stocks of copper metal and scrap in Europe, amounting to 220 million pounds, or a total of 460 million pounds, which leaves an apparent world's consumption of 2970 million pounds. This exceeds the production for any year in the history of the copper industry.

PATENTS and patentees have been discussed in our pages from time to time, partly from the point of view of rewarding genuine invention and partly from

sympathy with those who are victimized by the piratic exploitation of the rights accruing under governmental license. Therefore we have read an account of the new British Patents Act with some curiosity. In the first place, the law has been changed so that the invalidity of a single claim will not invalidate the whole patent; the infringer can only escape liability by disproving the claim under which he is sued; it is no longer sufficient for the infringer simply to prove the invalidity of any claim. This will help the patentee. Better still, provisions have been introduced whereby a person is enabled without great expense to go before the Comptroller of Patents, an official invested with extensive judicial powers, and obtain from him a compulsory license or a revocation of the patent in cases where the monopoly has been abused by extravagant or unreasonable exactions on the part of the patentee, or if the patent is used to check domestic manufacture to the advantage of importations from abroad. Moreover, a limit of four years is set to an idle patent, if not worked within the country on a commercial scale and no satisfactory reason therefor is forthcoming within the specified period. We obtain this information from an article by Mr. Benj. T. King in the 'Mining World', of London. Mr. King observes very truly that the law is defective in so far as it leans heavily on judicial decisions; nor, may we add, does it provide for the creation of a tribunal specially qualified, by technical education, to adjudicate intelligently. However, we like that idea of a Comptroller, who, like the Commissioner of Patents in Canada, is in a position to discipline a patentee when he is extortionate or unreasonable in his exactions.

A 'CHILE-AMERICAN Association Mining Scholarship' has recently been established by the appropriation of funds sufficient to provide adequately for the traveling and living expenses as well as the tuition of an undergraduate student in mining and metallurgical engineering at the Massachusetts Institute of Technology. The industrial progress of Chile is largely dependent upon the successful development of its mineral resources, which form the greater part of the country's natural wealth. It is estimated that capital aggregating \$150,000,000 has already been invested there by mining interests in the United States and it was with a view to promoting mutual understanding and good feeling that the Chile-American Association was formed. Its membership includes most of the larger American companies doing business in Chile, as well as some individuals who are taking part in the exploitation of the country. While there are a number of mining schools in Chile the opportunity for young graduates to supplement their training with a three-year course in our country will have the dual advantage of affording technical training with a wider scope and an acquaintance with North American customs and ideas that will assist in furthering pleasant and agreeable relations when the young Chilean returns to start his engineering career in his own country. The announced intention is to choose the recipient of the scholarship from among recent graduates of the Chilean

mining schools by means of a competitive examination, the successful competitor to be formally designated by the President of the Republic. It is to be hoped that the selection is actually as well as nominally based on merit, that the youth selected will have, as far as can be predetermined, the qualities of mind and character calculated to make him a successful mining engineer, rather than the political or financial connections that might obtain for him undeserved preferment. The whole plan is a good one and we have no reason to doubt that it will be properly administered.

OUR friend the 'Hyder Alaska Miner' makes this announcement at the top of its editorial page: "A newspaper whose purpose is to tell the world about the newest and busiest town in the Northland, and the native resources which are responsible for its existence." This is frank and to the point; moreover our curiosity is excited by "native" resources. By way of further enlightenment it declares Hyder to be the "gateway to the great Salmon River mineral area at the door of the famous Premier mine", and adds "you have to come to Hyder to reach the mines". Apparently the question of route is a matter of Hobson's choice; a disagreeable one, you might infer, with Hyder conceding that it is rather shy on attractions of its own. Nevertheless both the 'Miner' and the Hyder Commercial Association take vigorous exception to what is termed a "libelous interview with a representative of steamship interests", published in a Seattle newspaper. It appears that the gentleman interviewed questioned the ability of Hyder to outfit prospectors; declared that the town was built on piling; doubted its ability to accommodate transient visitors; and reflected upon the character of the drinking-water; all and sundry of which aspersions evoked strenuous protest from the citizens of Hyder, who now answer each indictment in detail. The leading merchant has just finished invoicing a stock of miscellaneous supplies valued at \$23,000. This figure really would have been more impressive five years ago; however, in addition it is pointed out that Prince Rupert is but 24 hours distant by boat, so that further supplies can be obtained readily, if needed to outfit prospectors. As to being built on piles, Hyder pleads guilty to the charge; it makes no apology, but points with pride to Aberdeen and Seattle as glittering examples of success achieved on an underpinning of piles. The answer to number three is the existence of "two large hotels and five rooming-houses, each of the latter being able to accommodate from 12 to 50 roomers". These statistics of hotel capacity are admittedly rather vague; and we venture to advise anyone going that way to provide himself with a substantial bed-roll before leaving Seattle, on the theory that it's better to be safe than sorry. The water must certainly be good, else there would have been a "mortality list ere this". Moreover, the 'Miner' assures us that "there are ten wells in the piled district, all driven into a subterranean stratum and all producing water which is good for anyone who likes water". It is reassuring to know that the stratum

is subterranean, although we feel some concern for the visitor who doesn't care for water. Are there other available liquids besides the products of these excellent wells? We hardly believe that the representative of the shipping interests had any motive in misrepresenting conditions in Hyder or that Hyder will suffer as a result of what he did say. The men who go in search of gold and silver do not expect to find the convenience of Wanamaker's or the comforts of the Waldorf on the fringe of the frontier. Perhaps Hyder disdains gratuitous advice; nevertheless we suggest that it is poor policy to declare as vociferously as Hiram Johnson that the fortune-seekers must go through Hyder, intimating that it is a necessary though disagreeable part of the journey to the mines. If one has a monopoly, why gloat over it? A more tactful scheme would be to point out the pleasant features of a brief sojourn at Hyder; for instance, its splendid site on the bay, its salubrious climate, its inexhaustible supply of pure Alaskan air, and, may we suggest, the excellent accommodations of the commodious Hotel Metropole. Incidentally the 'Miner' advises that the snow will not be melted so as to permit successful prospecting before June 1. Let us go thither then!

Mr. Hoover Will Accept Nomination

Soon after we went to press last week, namely, on March 30, the political situation was clarified, particularly for Mr. Hoover's friends and supporters, by the telegrams sent by him to Messrs. Warren Gregory and Ralph Merritt, both in San Francisco. We reproduce these telegrams on page 549. In the first Mr. Hoover states that he is convinced that it is his duty to confirm the action his Republican friends in California have taken without consulting him. We like particularly the sentence: "The issue is whether, with reservations protecting our position, we should join the moral forces of the world to reduce the dangers again growing around us, or whether we will, *by pretense of an insularity that we do not possess*, sit by in the face of growing armies, navies, national antagonisms, reactions, or, in reverse, the spread of bolshevism, through much of the world." The italics are ours. The Treaty of Peace and the League of Nations are discussed more specifically in the message to Mr. Merritt, which concludes thus: "Two years ago when the entire world was aligned against Germany, our prayer was that we might be fighting the last great war—that something better should come to the world in return for the sacrifice. Today the world is drifting back, and through our failure victory may turn to new antagonisms." Both messages deserve to be read carefully. They show once more that Herbert Hoover is a statesman as well as an engineer. They will appeal to the enlightened spirit of a true Americanism, as distinguished from the sentimental internationalism of President Wilson and the frothy provincialism of Mr. Johnson. Here we may note that sundry irresponsible newspapers have misquoted the New York 'Times' as having endorsed Senator Johnson's candidacy. We read the 'Times' ourselves and were not deceived. In its

issue of Sunday, March 21, it said editorially that "if Mr. Lodge is to be approved and sustained, logic and consistency point unerringly to Hiram Johnson as the man to be nominated by the Republicans". The italics are ours. And it followed this by saying: "It would be a calamity for the country. We should regard with great apprehension the nomination of Senator Johnson." So would many of us. Another perversion of the truth is the assertion by Mr. Jonathan Bourne, Jr., president of the Republican Publicity Association, that a number of newspapers and periodicals of the country have been organized into "a perfectly operating machine" for Mr. Hoover. Mr. Bourne remarks that "the Hoover machine is well constructed and evidently well supplied with fuel and oil and grease". Similar suggestions have been made by Mr. Johnson. It may interest our readers to know that we, for example, have not talked or corresponded with Mr. Hoover since last October, when he had nothing to say about the possibilities of his candidacy for the Presidency. His talk was all about economic conditions in Europe and in this country. We believe that the propaganda of other newspapers and periodicals has been like our own, wholly spontaneous. We know also that his friends in California, who in the end succeeded in getting him to acquiesce in their efforts on his behalf, as a candidate on the Republican ticket, acted entirely on their own initiative and took the risk of being made to appear foolish if Mr. Hoover had finally refused to accede to their importunities. The fact is Mr. Hoover's candidacy is the product of a genuine popular call. The political machines, especially Mr. Johnson's, do not approve of such direct action; they have come to regard themselves as the last word in politics; they resent the ordinary citizen's trespass upon their preserves. The Hoover campaign will show whether the mass of the people can express their desires in opposition to the powers that be. In California Mr. Hoover is opposed by a political machine that has been perfected by a most adroit and experienced politician. It remains to be seen whether the perpetually indignant Mr. Johnson or the great Food Administrator can win the more votes. The issue is clear.

Industrial Relations

The production, in general, of the individual wage-earner today, as compared with that of 1914, has decreased between 15 and 50%, depending upon the particular industry and upon local conditions. This fact is incontrovertible. On the other hand, there is urgent need for increased output of most commodities, and until this increase is an accomplished fact, prices, as far as can be foreseen, will not decline. The seriousness of this economic crisis is being explained to the workers and they are being urged to apply themselves with at least pre-war efficiency to their tasks, with a view to reducing the present level of prices and thereby directly benefiting themselves. However, it is difficult to convince the average wage-worker that such action on his part is really to his advantage, and that such a program offers any

tangible benefit to himself and to his family. He reasons that if production is increased to the normal point where it exceeds consumption there will be an over-supply of labor instead of the present shortage; that jobs will become scarce and that wages will drop, necessarily. There is today a widespread and implicit understanding among laboring men to restrict individual production, thereby maintaining the present level of wages, no matter what may be the effect on commodity prices. This condition of affairs obtains in the mining industry. The problem is to alter the attitude of the miner and to offer him a definite inducement or incentive to work hard. The paper by Mr. Edwin Higgins, appearing in our issue of February 28, outlined in a comprehensive way various measures that should be taken to obtain co-operation and willing effort from the miner. Attention to sanitation, safety, and first-aid, the improvement of working conditions, various social-service and welfare activities, and the practice of the square deal all are variously contributory to efficient operation. The progressive manager, however, has realized the mutual benefit of adopting these ideas and has made headway, in some degree, toward putting them into effect. There remains, as the main issue between the employer and the employee, the question of financial remuneration, whether in the form of wages or otherwise, for service performed. The principle of the square deal must be made to apply to the miner's pay as well as to other relations; confidence in the financial honesty of the company must become rooted in the employees, so as to assure them of fair treatment as long as the business thrives; and a system of payment must be devised that will recognize competence and diligence. The average miner really believes that the wealthy owners of the mine are pocketing enormous profits, that this is entirely unearned, and that it represents the exploitation of the wage-earner, who himself has to forego all the good things of life. It has been suggested that the public posting of a company's operating accounts each month would promote confidence and good-will even though some of the miners might not understand the meaning of all the figures given. Certain large mining companies that had been paying really excessive dividends during the War immediately cut the wages of their men when the price of metals fell early in 1919; although the war wages were no more than enough to provide a mere livelihood for the head of a family and the cost of living showed no prospects of decrease. The fact that some of the companies returned to the former scale after a brief interval indicates that possibly they themselves concluded that the cut had been ill advised. However, from the point of view of the laboring man, such arbitrary action suggested an utter disregard for his welfare, and seemed to support the idea that distribution of dividends was the paramount consideration of the employer. Such inconsiderateness may account to some extent for the present antagonistic attitude of the wage-earners, many of whom sincerely, though mistakenly, think that they are doing the best thing for themselves by restricting output. It will require time and it will need the continued use of the square deal on the part of managers

everywhere to inspire the necessary confidence in the broad-gauge honesty of employers. There remains one important influence that can have an immediate good effect on the efficiency of operation: If a miner knows that the harder he works the more money he will receive on pay-day, he is strongly inclined to put forth his best effort.

Schemes for paying miners may be grouped under four heads, namely, (1) day's pay, (2) contract or piece work, (3) task and bonus, and (4) co-operative bonus. The only way to get reasonable efficiency by the straight day's pay method is to make the scale of wages in a given district sufficiently high to attract a surplus of first-class men; a miner will then do an average day's work in order to avoid being discharged; but there is little inducement to extra effort. Moreover, the scheme is unscientific, in that it makes no provision for extra pay for exceptional service. In the second plan, payment is based on cubic volume of rock broken, the number of feet advanced, the number of cars trammed, or some other unit. This method is in disrepute because of the former practice, particularly in shop-work, where the piece system originated, of cutting rates when workmen became expert. This was obviously bad faith on the part of the employer. Nevertheless the contract system has the merit of paying each man in proportion to what he accomplishes, and if honestly and fairly administered has advantages that more than offset its shortcomings. In our last issue there was an article by Mr. A. K. Knickerbocker in which he discusses the contract system as applied in the Minnesota iron mines. He reveals his close contact with the miners, and a sympathetic study of their point of view, no less than a clear comprehension of the problem as it appears to the mine manager. The 'task and bonus' plan is a refinement of the contract scheme, and at the same time has distinctive features of its own. A standard time-equivalent for each detail of work is first determined and a complete record of the performance of each miner is kept. The required task may be set at any percentage of the standard and the bonus is based on any accomplishment over and above the task. Every man in the mine can be included. The co-operative bonus plan distributes to every employee who works a specified number of days an equal share of a sum determined from the net result of all operations over a period of a month. It has the merit of encouraging co-operation to a maximum degree; but it makes no distinction between the good man and the extra good one. While it has notable successes to its credit in other industries, it is objectionable as being a kind of profit-sharing scheme; and it is not easily applied to mining operations. There are today many individual plants operating at maximum efficiency, in the midst of an immense majority where the production per man has notably decreased. They are doing this because they pay their men well and scientifically; because their employees are reasonably certain of something more than a 'living' wage so long as the particular industry flourishes; and because there is a spirit of mutual trust and fairness between employer and employee.

DISCUSSION



The Combination Method of Mine Sampling

The Editor:

Sir—Mr. Morton Webber's article in your issue of February 28, on this subject, is especially valuable and interesting at this time, owing to the revival of silver mining. Anyone who engages in the sampling of silver mines soon learns that the true average grade of the ore in a large proportion of these mines cannot be accurately determined by hand sampling alone. It is necessary in many cases, to supplement the hand sampling by some other method, and the 'combination' method described by Mr. Webber should give satisfactory results in nearly every instance.

I would suggest, however, that the misleading term, mill-test, should be discarded in favor of a more accurate term, such as 'bulk-sampling', because this method is in no sense a mill or metallurgical test but is for the sole purpose of determining the gross grade of the ore or rock sampled. It is usually necessary to have metallurgical tests made in addition to any method of sampling. The result of the bulk-sampling can also be more satisfactorily and accurately obtained, as Mr. Webber states, by means of a bulk-sample rather than by milling.

San Francisco, March 22.

FRED H. DAKIN.

The Metallurgy of Complex Low-Grade Ores

The Editor:

Sir—Bulletin No. 9, issued by the Utah Engineering Experiment Station of the U. S. Bureau of Mines at Salt Lake City, states, on page 28, in part:

"Sulphurous acid leaching of copper from its ores is technically feasible and the department in conjunction with its co-workers has tested out a number of pieces of machinery in order to dispose of the mechanical difficulties which have previously interfered with the successful application of the method."

Dr. F. C. Cottrell, having in mind the 2000-odd tons of sulphuric acid gas that are being daily wasted at various establishments recently prophesied while at Butte that "the future advances in science would largely be concerned with gases".

These statements are practically the "first official guns" to announce the new metallurgy, namely, hydrometallurgy in a form embodying more chemical and metallurgical correctness of application than heretofore was thought possible of application.

Leaching with sulphuric acid presents nothing new,

as in some modification or other it has been practised for a great many years, and in reviewing its method of manufacture and application to ores in general, one cannot but realize the cumbersomeness of the solvent itself, likewise its application. For example, ordinary commercial sulphuric acid may contain about 50% of water, and this water in the chamber process of making the acid is necessarily present, hence it presents costs in terms of the strength of the acid produced. In shipping the acid, containers have to be provided to hold both the acid and the water; the railroad and hauling charges have to be paid for on the water in terms of acid. Elimination of a great part of the water can be effected by concentrating the acid, but the purchaser will generally find the price advanced beyond the economy obtained over the purchase price of the commercial article.

Absolutely pure sulphuric acid contains 18.41% of water as a matter of chemical necessity in its make-up, so that it becomes obvious that "some water" must be taken by anyone using sulphuric acid; besides, the strongest acid that can be readily handled is but 97% pure, containing 3% impurities, mostly water, in addition to that mentioned above.

The erection of a plant to manufacture oil of vitriol is not a poor man's opportunity. The construction of an Eastern company for its 500-ton acid plant was \$1,689,925. That of a Western mining company with a normal capacity of 100 tons acid per 24 hours was \$470,000. The above installations, however, have been forced much beyond their normal capacity. The plant deterioration has likewise been found to be excessive.

Previous to the construction of the Western plant, Denver or Coast points furnished the acid and the transportation and hauling was no mean portion of the total cost. The acid-makers have been quite fortunate in the matter of payment of dividends, so that the apparent cheapness of sulphuric acid may not be cheapness at all when the original cost of production is given due consideration.

The primary step in fabricating oil of vitriol is burning sulphur, either in a metalloidal state, or combined as a sulphide to form sulphur di-oxide gas. This step is simplicity itself, sulphur readily igniting and burning to sulphur di-oxide gas practically alone. Nature wisely provided that sulphur could not directly be oxidized to sulphur tri-oxide and then by union with moisture become sulphuric acid, otherwise the roasting of sulphide ores would be almost impossible.

This provision of nature, however, has its drawback, inasmuch as an expensive plant is necessary to carry on

the oxidation of sulphur di-oxide gas to sulphuric acid. Here engineers failed to recognize, and, figuratively speaking, cast aside and made an enemy of the simple and effective natural acid that nature was making for them, choosing, as it were, the most difficult and expensive way of overcoming a difficulty which the new line of thought, embodying the utilization of waste sulphurous gases in the recovery of various metals and by-products, as applied in the sulphur di-oxide process. It has been experimentally proved to be highly successful in the treatment of complex low-grade ores of zinc, lead, silver, manganese, tungsten, and the like, that are to be found in great abundance here in Nevada, and thus far not utilized.

C. S. VADNER.

Reno, Nevada, March 19.

Chloridizing Processes

The Editor:

Sir—I have read Mr. Croasdale's pleasant communication and some of those referred to in your issue of February 21, and I am still of the opinion that he did not recognize the importance of rapid heating in chloridizing volatilization processes that were not dependent upon reactions in which sulphur was to be considered.

It appears that Mr. Croasdale's latter proposal, to feed the furnaces with a small stream of ore, was for the purpose of causing the ore to be more rapidly and thoroughly exposed to the oxidizing atmosphere of the furnace, and to provide a thinner bed through which the volatile chlorides could escape more easily than would be the case with the thicker bed. Mr. Croasdale's writings show that his predominating ideas on the necessary conditions for chloridizing volatilization are that sulphur must be present and that the particles of ore must be thoroughly exposed to an oxidizing atmosphere by means of continuous rabbling or rolling of the ore. He claims that rapid volatilization depends upon rapid oxidation, which is accomplished by rapid rabbling or rolling of the ore. In order to realize Mr. Croasdale's reactions, it was probably necessary to expose the ore thoroughly to an oxidizing atmosphere, but this could probably be better accomplished by means of small or rather thin streams of ore and frequent rabbling. His reference to the fact that the operation must be done quickly in order to make it commercial is not made in the sense that I intended to convey in my article and does not consider rapid beating in the same sense as I considered it. It is obvious that if an operation required so much time as to cause great expense such an operation would not be likely to prove a commercial success.

I have found that where the metals are so exposed or so combined as to be easily chloridized their chlorides are volatilized practically as rapidly as they can be brought to the proper temperature and that the chloridation and commercial volatilization are effected in such cases of easily chloridized ores within a very few minutes—less than ten minutes in some cases—after the ore had been brought to the proper temperature. I have not found it

necessary to rabble or expose the particles of ore to oxidizing atmospheres when using some of my methods on oxidized or carbonate ores.

In my original article, I failed to mention that slow heating in the case of some ores caused the chloridizing agent to be decomposed and the chlorine completely driven from the ore in less than fifteen minutes from the time the cold ore was charged into the furnace and that the chlorine was driven from the ore without any appreciable extraction of silver. In one of these cases, over 15% chloridizing agent was added to the ore. A long revolving furnace fired at the discharge end certainly would not be suitable for such an ore. I have lately been working on a lead-silver ore that yields as good if not better extractions of the silver under reducing conditions than those which could be obtained under oxidizing conditions.

HARAI R. LAYNG.

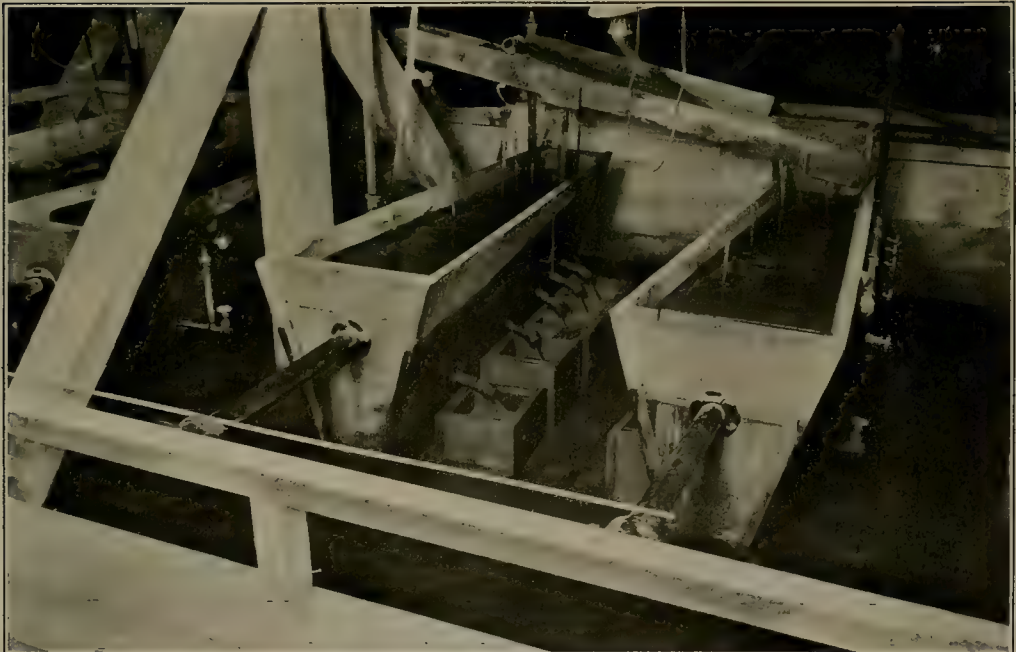
San Francisco, March 4.

OSMIRIDIUM deposits in Papua have been known for many years. It occurs in association with gold, and in the beginning it was treated as base metal and thrown away, just as it used to be in Tasmania, where the prospectors looked upon it as a nuisance. Those miners in Papua who sent it to the banks, or the mint, with their gold, found that it was accounted base metal, and upon discovering that it was of much greater value than gold, believed that they were receiving unfair treatment; but the mints, on the other hand, complain that the presence of osmiridium with the gold is a serious trouble, as unless they are quite separated, the particles of osmiridium in the melted gold have the effect of defacing the dies used in coining. There are considerable quantities of serpentine in Papua, and it is notable that in the districts where this abounds osmiridium occurs in association with only small quantities of gold. It has so far been recovered only by gold diggers as a by-product, but the best deposits will not be found until it is made the principal object of search. It occurs in a flaky form in the Lakekamu district; in a form not unlike native bismuth in the Yodda valley; and elsewhere in shot-like granules.

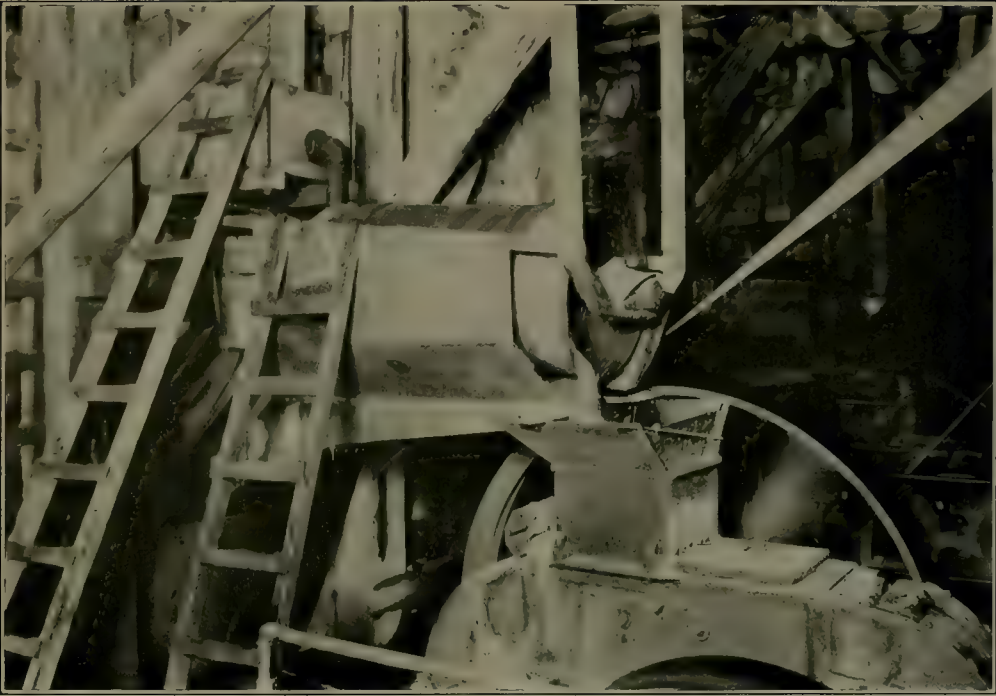
TIN, in spite of the unsettled state of the metal market, appears to be able to hold its own. The needs of the War did not force its increased production, as was the case with copper and lead, for instance, and consequently at the cessation of hostilities no large stocks were on hand. In fact, in spite of the extremely high price it reached during the late stages of the War, the output has decreased; this was especially the case in Australia. During the period of scarcity of tin-plates and very high prices for them and for tin, attempts were made to find substitutes. Some were successful up to a certain point, but they cannot compete when steel and tin are at normal rates. The average price of tin for the month of September 1918 was £344 per ton, but after the Armistice it fell, until February 1919 the average price was £223. Since that date there has been a steady increase.



WEST No. 2 MILL, WITH NORTH MILL IN BACKGROUND



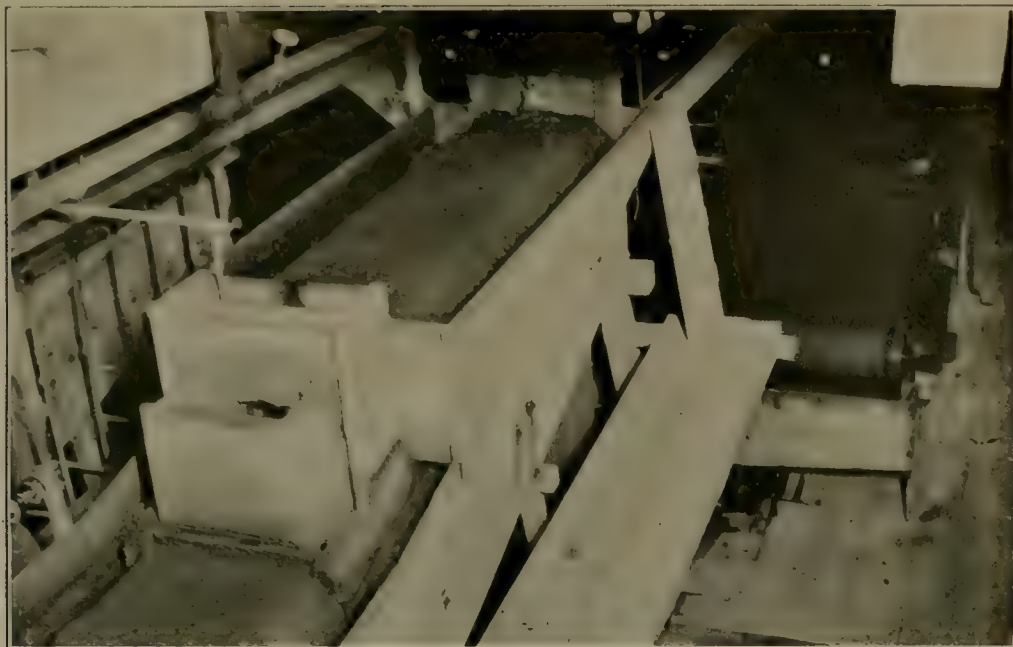
CALUMET HYDRAULIC CLASSIFIER



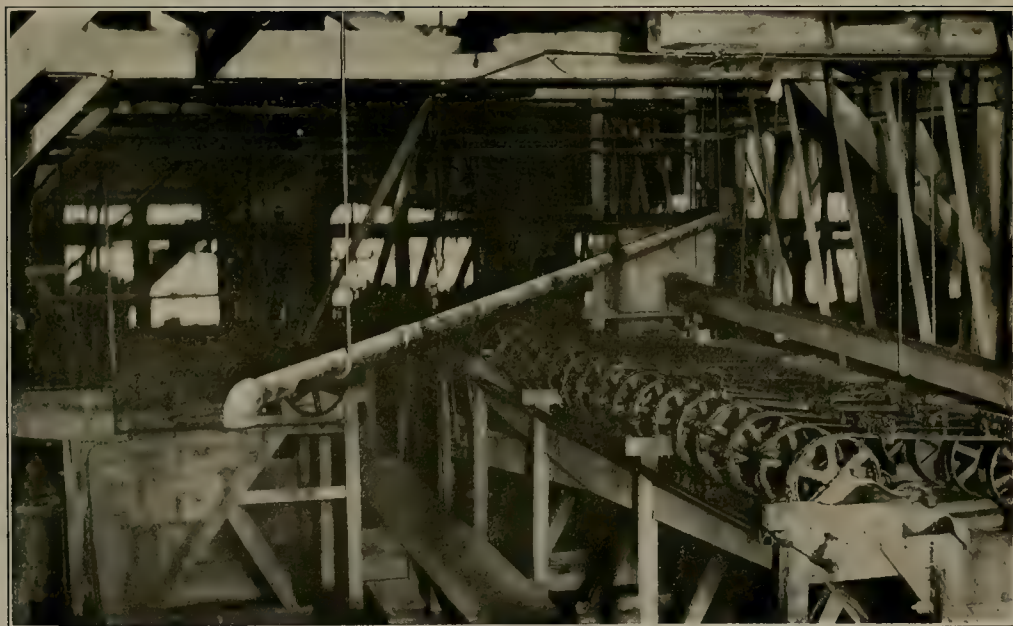
TROMMEL ROLL-FEEDERS



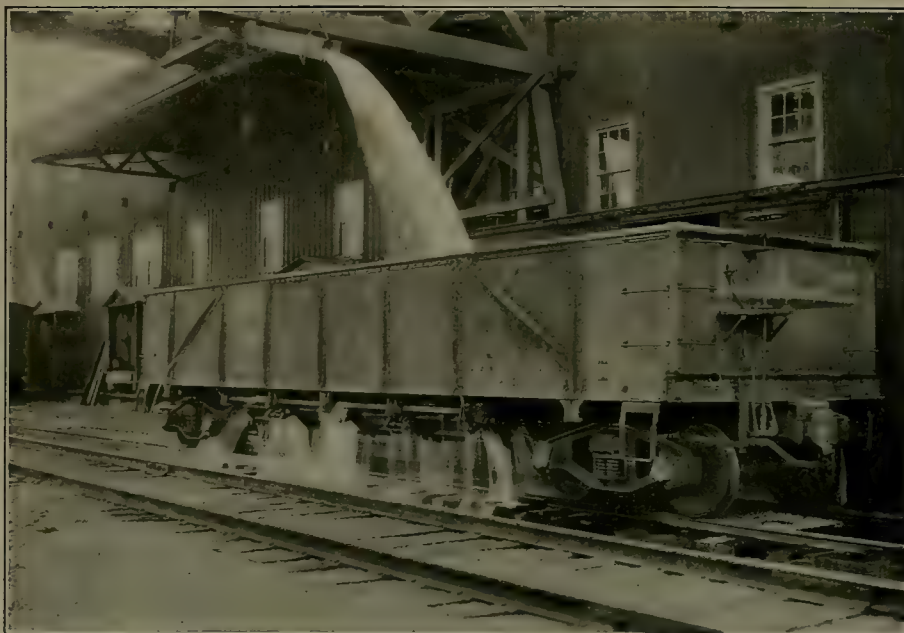
PART OF TABLE FLOOR IN THE WEST MILL



CALLOW CELLS TREATING TAILING



FLOTATION PLANT, SHOWING METHOD OF SKIMMING THE FROTH



DISCHARGING TAILING INTO RAILROAD CAR



CARS LOADED WITH TAILING. FARTHEST CAR RECEIVING THE TAILING

The Bunker Hill Enterprise—VIII

The Present Mill and Its Operations

By T. A. RICKARD

The ore coming out of the mine through the Kellogg adit is delivered by electric trains into a storage-bin of 1400 tons capacity. From the bin it passes through open chutes onto a 42-in. belt-conveyor, the speed of which varies from 17 to 55 ft. per minute, as regulated by a Reeves variable-speed drive. The essential feature of this device is a double cone supporting a belt mounted on wooden blocks cut to the taper of the cone that gives the friction to the drive. The interval between the cones, and the consequent diameter, is increased or decreased by a sprocket control.

The mine-run of ore carried by the belt-conveyor passes under a 36-in. electro-magnet, which removes hammer-

heads and other pieces of steel; thence the ore falls over a grizzly having 1½-in. openings and into two No. 5 bronze-ball crushers, the discharge from which joins the undersize from the grizzly and is conveyed on a belt to three trommels of 30-mm. screen. The undersize from the trommels passes to a storage-bin, while the oversize is removed to a 36-in. Symons vertical-disc crusher, set to ¼ inch, or 20 mm. The discharge from the crusher is conveyed to one 30-mm. trommel, the undersize from which goes to the storage-bin, while the oversize joins the discharge from the crushers, in closed circuit. This completes the crushing operations. See Fig. 7. Next comes the coarse concentrating and grinding. From the stor-

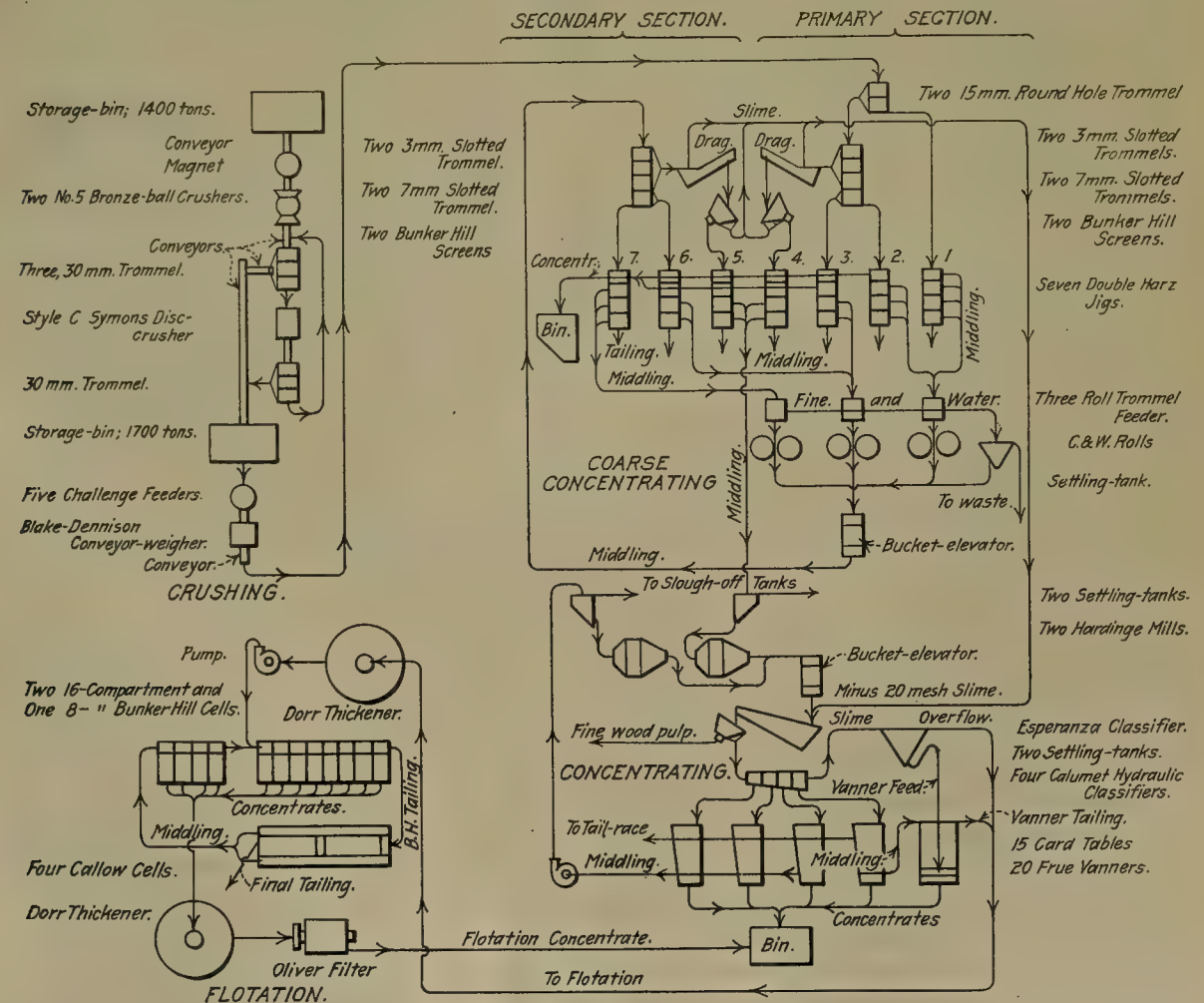


FIG. 7. FLOW-SHEET OF WEST MILL No. 2

age-bin the ore is fed by five belt-driven Challenge feeders to a belt-conveyor inclined at an angle of $22^{\circ}30'$. The belt-driven feeders give a remarkably uniform supply and require the minimum of attention, as the $\frac{1}{4}$ -inch wearing-plate on the revolving disc will last for a year. The feeders are driven from the tail-pulley of the conveyor. A third of the way up the conveyor-incline the stream of ore passes over a Blake-Dennison weighing-machine, made at Leeds, England. The accuracy of the weighing is indicated by the fact that the error is less than 0.5%. It should not be necessary to emphasize the importance of an accurate weighing and an equally accurate assay of the ore, in order to know at all times the quality and quantity, that is, the metal contents and tonnage, of the mill-feed, for this constitutes the basis upon which the entire economic result is predicated.

The belt-conveyor discharges into a revolving distributor of the vertical barrel type, so as to divide the stream of ore equally between the two sections of the mill. From this point one section only will be described, the other half being now a duplicate, although originally it was different.

From the distributor the crushed ore falls into two 15-mm. round-hole trommels (48 in. diam. and 60 in. long), the oversize from which passes to three four-compartment Harz jigs, while the undersize goes to two 48-in. trommels divided into four sections, each section being 30 in. long, three of 3 mm. by 6 mm. slot-screens, and one section of 7 mm. by $\frac{1}{2}$ -in. slots. These slots are aligned with the circumference and give a more effective clearance, which means a larger capacity. The oversize from the 7-mm. section goes to two four-compartment Harz jigs, and the undersize to one jig of the same kind. The undersize from the 3-mm. section of the trommel passes to a 6-in. belt-drag classifier, which separates the slime as an overflow that goes to the fine-concentration department, while the sand is delivered to two Bunker Hill screens equipped with 22-mesh Ton-Cap screening. The oversize from these goes to two jigs, similar to the above, while the undersize joins the overflow from the drags and passes forward to the fine-concentration department.

Turning to the jigs: these are built at the mill after designs by Mr. Caetani. Each cup is placed in the centre of the end of each compartment, instead of being in the centre of the side. Experience has shown that whereas this arrangement equalizes the draft from the bed, it complicates repairs by making it necessary to remove the discharge-pipe frequently; and this is a difficult operation because the pipe becomes so wedged by fine sand as to require the use of a chain-block to remove it.

The No. 1 jigs, treating the material between 15 mm. and 30 mm., do not yield any concentrate of shipping grade; they produce a large tonnage of low-grade (0.4 to 0.5% lead) tailing, which goes to waste, and a middling consisting of mixed lead and siderite, as well as particles of clean galena, the product assaying 18 to 25% lead. This goes to the coarse rolls. From the No. 2 jigs, treating material between 7 and 15 mm. size, the first cup yields a finished concentrate assaying 65%; three cups yield a middling, assaying 10 to 13% lead which

normally goes to the intermediate rolls, but occasionally the product from the second cup is diverted for the use of the smelter, as flux, on account of its high iron content. These jigs discharge a tailing, containing 0.7 to 1.0% lead.

The No. 3 jigs, treating material between 3 and 7 mm., yield from the first cup a finished concentrate assaying 75%, a finished product from the second cup assaying 65%, and from two cups a middling assaying about 7 to 10% lead. The third cup is periodically diverted to the smelter, for flux, as stated above. The tailings from these jigs assay 1 to 1.2% lead and are sent over the dump.

The No. 4 jigs, treating material between 3 mm. and 20-mesh, give a finished (77%) product from the first cup, another similar 70% product from the second cup, and a middling (assaying 8 to 10%) from the third and fourth cups. This middling normally goes to the rolls, but, as before, it may be diverted periodically direct to the smelter. The last cup discharges a silicious product, made in order to produce a clean tailing, and is therefore not wanted by the smelter. The tailings from these jigs assay 1.3 to 1.5% lead and go to waste. The hutch products are included in the cup products from most of the jigs and do not call for separate description, being of about the same grade.

The middlings from the No. 1 and No. 2 jigs pass to a set of coarse rolls, 36 by 14 in., made by Chalmers & Williams, while the middlings from the No. 3 and No. 6 jigs go to the intermediate rolls, of the same size and make. The middlings from the No. 4 and No. 5 jigs pass to the fine-concentration department. The discharge from each of these sets of rolls is raised by a 16-in. bucket-elevator to the middling section of the mill, which is an exact duplicate of that which treats the original feed from 15 mm. size down. The products from the No. 6 jigs in this secondary section go to the rolls, there joining the primary middlings. The middlings from the No. 7 jigs pass to another, or third, set of rolls of similar size and make.

Each set of rolls is provided with a trommel-feeder, consisting of one section 30 in. long and 24 in. diameter of punched steel-plate having 3-mm. holes. This feeder distributes the millstuff uniformly over the face of the rolls, and at the same time removes the excess of water, which is settled in a V-tank. The overflow from this tank goes to waste; the discharge from the spigot of the tank serves to wash the discharge from the rolls into the elevator already mentioned. This arrangement serves to provide a constant volume of water for the slime through the sizing system of the secondary section. The thickened pulp from the V-tank feeds twenty-one 6-ft. Frue vanners, which make a finished concentrate (assaying 67%) and a tailing ($6\frac{1}{2}\%$) that goes to the flotation plant. This tailing joins the dirty overflow from the V-tank.

Next we come to the fine-concentration department. The middlings from the No. 4 and No. 5 jigs go to a settling-tank, the overflowing clear water from which goes to waste, while the spigot discharge feeds a Hardinge

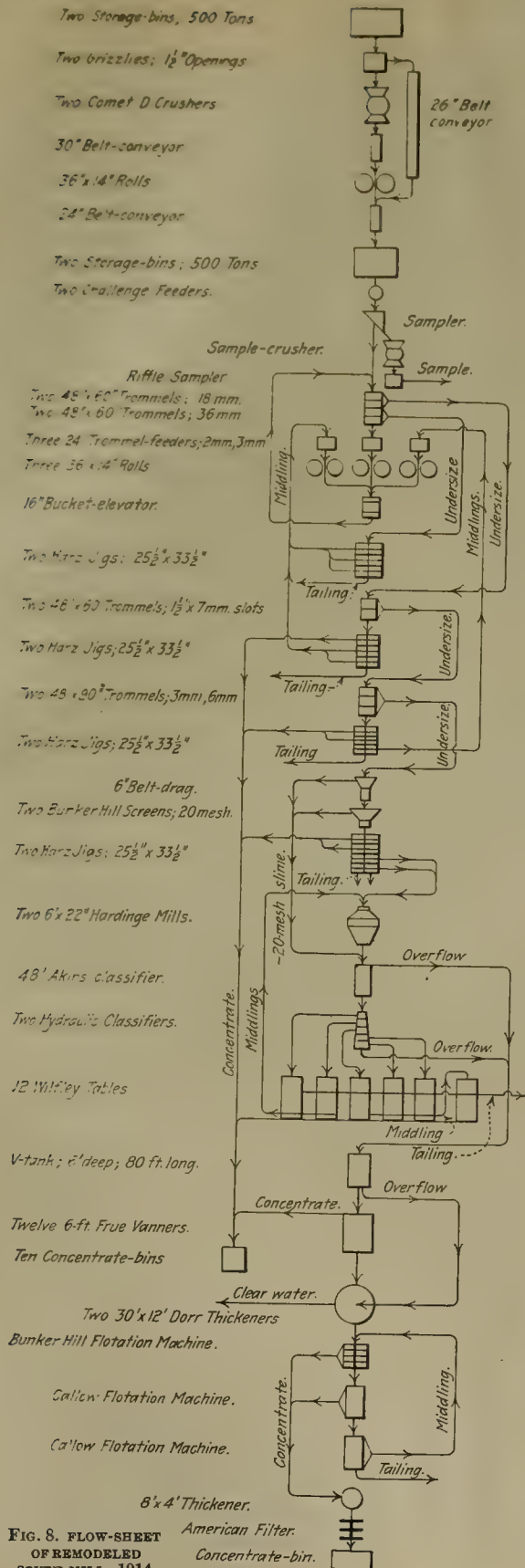


FIG. 8. FLOW-SHEET
OF REMODELED
SOUTH MILL, 1914

pebble-mill (6 ft. by 22 in.), by which it is reduced to minus 20-mesh. From there it goes to a 16-in. bucket-elevator, the discharge from which joins the minus 20-mesh products from the primary and secondary sections of the jig-floor. United these pass to an Esperanza (5 by 17 ft.) classifier, which separates the bulk of the slime (minus 200-mesh) from the sand. The slime is transferred to a V-shaped tank, which thickens the pulp (10:1, water:solid) for the vanners. The sand goes to three Calumet hydraulic classifiers, of five spigots each, which prepare it for treatment on the Card and Deister tables.

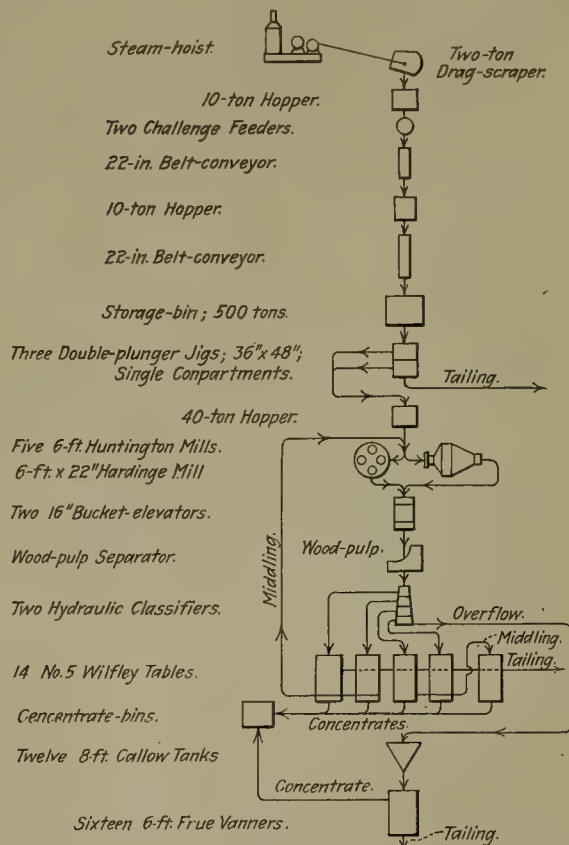


FIG. 9. FLOW-SHEET OF NORTH MILL WHEN TREATING
SOUTH MILL TAILING-DUMP, 1911-1913

These classifiers are equipped with cast-iron sorting-columns, as designed by the Bunker Hill staff. Between the Esperanza and the Calumet classifiers the removal of any wood-pulp is effected by the use of a Bunker Hill screen.

The tables are distributed thus: five tables to the first spigot, four to the second, three to the third, two to the fourth, two to the fifth spigot, and two for re-treatment of fine-table middlings. In this section all the 18 tables are Cards; in the other section there are 16 Cards and two Deisters (one 'Plateau' and one 'Plato'). Experience in this mill, says Mr. Handy, shows that the riffing is the determining factor, rather than the head-motion or any other detail of construction. The best riffing appears to be that on Plato table.

All the tables discharge a finished concentrate averag-

ing 72 to 74% lead, and a middling that in the case of the coarse (first and second spigots) tables is returned to a Hardinge pebble-mill (6 ft. by 22 in.) for re-grinding. The middlings from the fine tables (third, fourth, and fifth spigots) are returned over two middling-tables, making a concentrate, a middling that goes to the flotation plant, and a tailing that goes to waste. The tailings from the coarse tables assay 1.75 to 2% and go to waste; the tailings from the fine tables assay 1.5% and likewise go to waste.

The flotation department starts with a Dorr thickener (40 by 12 ft.), which dewateres the pulp to a 1:1 consistence. This pulp (at the rate of 95 dry tons per 24 hours) is delivered to two 16-cell Bunker Hill flotation machines, in which mechanical agitation is effected by eight 1½-in. centrifugal pumps in each machine. These use 1½ hp. per pump. The product is a concentrate assaying 60 to 65% lead; the tailing, assaying 3½ to 4%, is pumped to two sets of Callow standard double cells in series, the froth from which assays 30% lead; this froth is brought up to 45% in a Bunker Hill 8-cell cleaner, while the tailing (1%) goes to waste. The tailing from the cleaner is returned to the feed and dilutes it to a consistence of 3:1. The concentrate goes to a Dorr thickener (40 by 12 ft.), where its consistence is reduced to 35% moisture by an automatic intermittent discharge, regulated by an oscillating gate, operated by an eccentric and placed over the spigot. This passes to an Oliver filter (8 by 6 ft.), which reduces the moisture to 11%. On this filter the film of oil on the cake is removed by a 'flapper', consisting of rawhide strips, on a revolving wooden shaft, that impinge on the cake.

Only pine-oil is used: one gallon per day or 0.08 lb. per dry ton. I noted an absence of the aromatic odor usual in flotation plants.

Mazda C lights are used throughout the mill; they give a daylight effect, which is the reason why they were adopted first by silk salesmen.

Next we come to the remodeling of the Old South mill as adapted to the treatment of ore from the Sierra Nevada and Caledonia mines. See Fig. 8. As far as the head of the sizing system, the old flow-sheet (Fig. 3) was retained, the first noteworthy change being the substitution of slotted screens on the 7-mm. and 3-mm. trommels and the discarding of the 10-mm. trommel. The jigs were standardized with those in the West mill, except that the discharge was placed at the side instead of being in the centre of the end of the compartment. The undersize of the 3-mm. trommel was made to follow the same route as in the West mill No. 2 (See Fig. 7). The rolls were made standard (36 by 14 in.) with the West mill. The standardization of the trommels, drags, fine screens, jigs, rolls, elevators, and classifiers is an important factor in the economy of the various Bunker Hill plants.

Another feature of this remodeled Old South mill is the use of two belt-driven Hardinge pebble-mills (6 ft. by 22 in.) and the use of a 48-in. special Akins classifier, instead of the Esperanza machine. The flow-sheet of the flotation annex is identical in essential details with that

in the West No. 2 mill, except for its smaller scale.

Finally we come to the flow-sheet of the North mill after it had been remodeled, in 1911, for re-treating the tailing of the South mill dump. See Fig. 9. This tailing was excavated by a two-ton open-bottom drag operated by a double-drum steam hoisting-engine of 60 hp., delivering into a 10-ton hopper, from which it was fed by two belt-driven Challenge feeders to a 22-in. flat-belt conveyor, 600 ft. long. This delivered to a hopper feeding a 22-in. trough-belt conveyor set at 22° and discharging over a grizzly into a bin of 500 tons capacity. From this bin the tailing was washed through a chute into three double-plunger bull jigs of the Harz type, with a single (36 by 48 in.) compartment, provided with two gate-discharges. These jigs yielded a middling that assayed 6% and was delivered through a storage-bin to five 6-ft. Huntington mills and one Hardinge pebble-mill (6 ft. by 22 in.). The pulp from these mills passed through 20-mesh screens into two 16-in. bucket-elevators, which delivered it, through two stationary wood-pulp separators, to two hydraulic classifiers. The spigots of these classifiers fed 14 No. 5 Wilfley tables, while the overflow passed to twelve 8-ft. Callow tanks, the thickened discharge therefrom passing to sixteen 6-ft. Frue vanners. The products from the tables were a 35% concentrate, a 5% middling that was returned to the grinding machines, and a tailing (3%) that went to waste. The jig-tailings assayed 1% lead. This mill was operated during the summers of 1911, 1912, and 1913, treating 300,000 tons of tailing during this time.

In comparing the flow-sheets of the No. 1 and No. 2 West mills, it will be seen that in the first the controlling idea was to simplify the sizing system, which consisted of one set of 10-mm. trommels, and to finish the sizing in the jigs. The undersize from these trommels passed to classifying jigs, which, in addition to concentrating the sand, also separated a slime product. This entailed an excessive proportion of hutch product, which was so low-grade that it had to be re-concentrated. The tailing, of course, was high on account of the variable size of the material fed to the jigs. Meanwhile the concentrate (assaying 45%) from the coarse jigs was ground in Huntington mills, the discharge from which was treated in hydraulic classifiers and fed to nine Card tables, yielding a 77% concentrate, a second concentrate of 60%, a middling of 15% that went to the grinding system, and a 7% tailing that went to waste. This, although it seems bad technically, was justified commercially by the saving in freight and treatment accomplished by keeping waste out of the high-grade concentrate that was shipped to the smelter.

In the No. 2 plant, the advantage of sizing is fully recognized, because a lower tailing and a higher concentrate can be made on a sized product, as against an unsized. Another point, on which Mr. Handy places emphasis, is that in making a low-grade concentrate only on the coarse jigs, a cleaner tailing is possible, the first concentrate being then crushed and re-jigged so as to produce a 65% product, as against the 53% product ob-

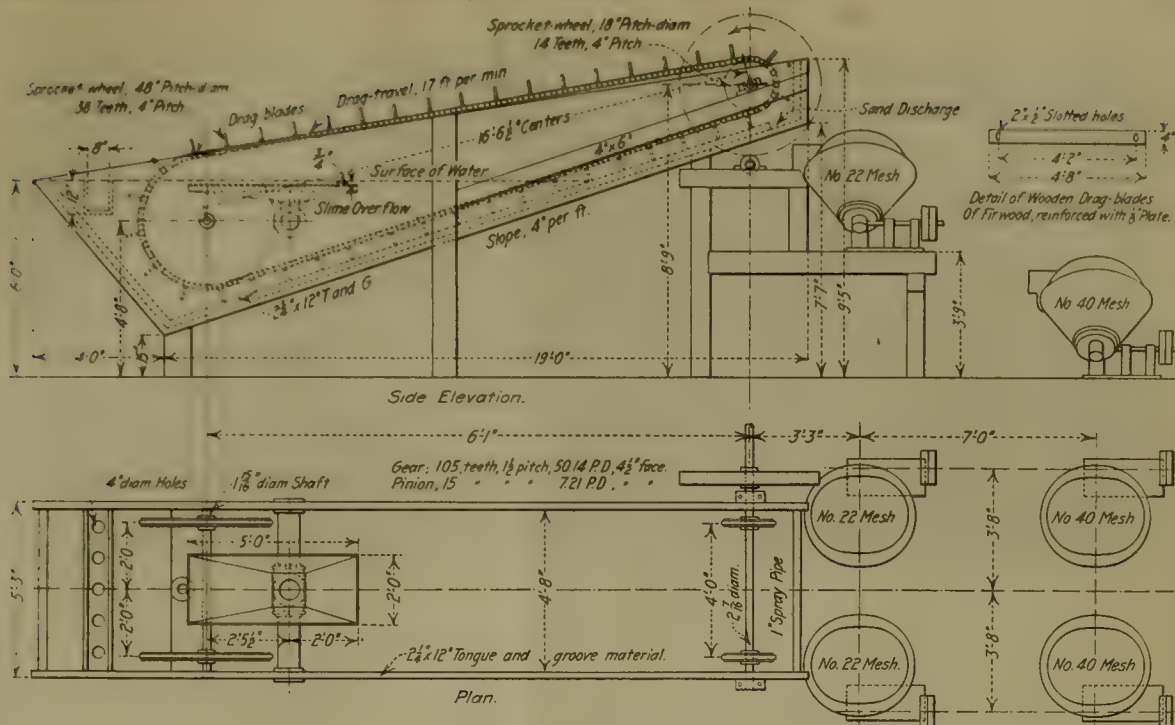


FIG. 10. ESPERANZA CLASSIFIER

tained by the first jiggling. This is due to a reduction in the size of the feed by passing it previously through the rolls.

It is interesting to note that the average monthly production of 77% concentrate in 1911 was 362 tons in the No. 1 section of the West mill, while the production of second-class concentrate was 719 tons and of slime 922 tons. This was the result of grinding the 45% product in the Huntington mills followed by re-concentration on tables. In August 1912, when the gradual reduction by rolls followed by re-jigging of the bull-jig concentrate had been established in the No. 2 section, the production of first-class (or 77%) had risen to 1010 tons, of second-class to 2616 tons, and of slime to 1183 tons monthly. Assuming that the No. 1 section was still working at the normal rate, this would give the production of the No. 2 section as 648 tons of first-class, 1897 tons of second-class, and 261 tons of slime. The 7% tailing that had been discarded in the grading was included automatically in the grinding system and went out with the regular table-tailings at probably not over 3% lead. In changing the

grinding practice from Huntington mills to rolls there were eliminated 13 tables, two bucket-elevators, one trommel, and two Huntington mills.

The Esperanza classifier was invented in the mill of that name, at El Oro, Mexico; it consists of a series of steel-armored wooden flights on a sprocket-chain moving up an incline of 30°, the effect being to drag the sand along the incline while allowing the slime to run back.

The practice in the Bunker Hill mills is to paint the launders so as to trace the various products. Yellow indicates middling, brown stands for concentrate, and gray for tailing.

The main tailing-laundry is lined along the sides with concrete slabs, 2 in. thick, 24 in. long, and 12 in. wide, made of tailing and cement. These slabs form a lining that is more satisfactory than cast-iron; they cost 20c. apiece, as against \$3.50 for cast-iron. The bottom of the laundry has cross-riffles, placed at intervals of 24 inches. These are made of white iron, $\frac{3}{4}$ in. thick, 6 in. high, and 24 in. long (the width of the flume). The tailing settles between the riffles and forms an indestructible bed.

SUMMARY OF PRODUCTS OF No. 2 WEST MILL

Machine Number		Tons	Feed		Concentrates			Middlings			Tailings		
			Assay	Contents	Tons	Assay	Contents	Tons	Assay	Contents	Tons	Assay	Contents
			Lead, %	Lead, tons		Lead, %	Lead, %		Lead, %	Lead, tons		Lead, %	Lead, tons
1	A Jigs	210	9.00	18.90	....	....	....	100	18.30	18.30	110	0.50	0.55
6	A "	100	11.50	11.50	8.00	69.00	5.50	45	13.00	5.80	45	1.00	0.45
6	B "	100	8.00	8.00	5.00	73.00	3.60	40	10.00	4.00	55	1.20	0.70
8	A "	110	7.50	8.25	5.00	75.00	3.70	50	8.00	4.00	45	1.50	0.70
4	A "	80	14.00	11.20	6.00	65.00	4.00	65	11.00	7.00	7	1.50	0.10
4	A-1 "	75	15.00	11.25	5.00	73.00	3.60	40	10.00	4.00	30	2.00	0.60
4	B-1 "	80	12.00	9.60	4.50	73.00	3.30	40	14.00	5.60	25	2.25	0.58
14	A Tables	185	15.00	27.63	20.00	74.00	14.80	60	14.00	10.30	75	2.00	1.50
14	B "	55	13.00	7.15	5.50	76.00	4.10	20	12.50	2.50	30	1.50	0.45
14	B-1 "	20	12.50	2.50	1.00	50.00	0.50	10	17.50	1.75	10	2.50	0.25
16	A-1 Vanners	100	11.00	11.00	8.00	67.00	5.40	90	6.50	6.00	...	...	...
18	B Flotation	100	8.00	8.00	14.00	50.00	6.90	2	17.00	0.34	85	1.00	0.85
	Total	.....	.....	.....	82.00	87.50	55.40	...	.....	...	517	1.20	6.21

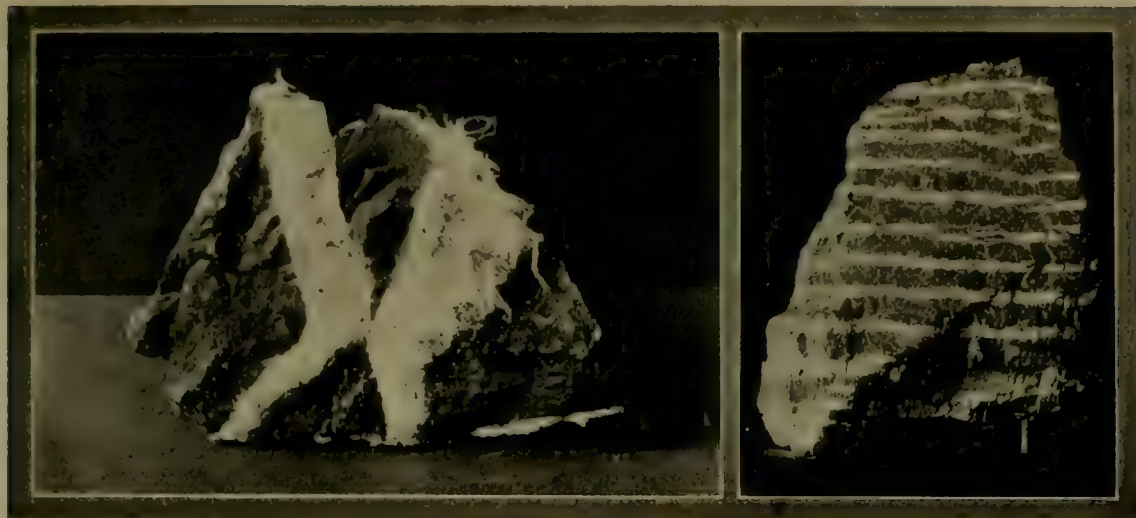
Screen		SCREEN-ANALYSIS OF PRODUCTS OF NO. 2 WEST MILL	
On 15 mm.	25.5	1	Mill-feed
" 7 " "	63.2	2	Feed to rolls No. 2
" 3 " "	51.1	3	Discharge from rolls No. 2
Through 3 " "	13.9	4	Feed to rolls No. 5
On 20 " "	4.4	6	Discharge from rolls No. 5
" 38 " "	20.1	6	Feed to rolls No. 7
" 35 " "	10.9	7	Discharge from rolls No. 7
" 35 " "	0.9	8	Overflow drag-belt classifier No. 6, C-1
" 48 " "	40.1	9	Feed to Harding pebble-mill No. 9
" 65 " "	30.9	10	Discharge from Harding pebble-mill No. 9
" 100 " "	1.65	11	Sand discharge Esperanza classifier No. 11, A
" 150 " "	94.53	12	First spigot No. 14
" 200 " "	1.36	13	Second spigot No. 14
Through 200 " "	1.30	14	Third spigot No. 14
*Through 48 " "	7.57	15	Fourth spigot No. 14
	8.36	16	Fifth spigot No. 14
	12.79	17	Overflow from No. 14
	13.9	18	Feed to Harding pebble-mill No. 15
	14.5	19	Overflow drag-belt classifier No. 4, B-1
	23.8	20	Overflow Esperanza classifier No. 11-B
	14.5		
	0.36		
	0.63		
	1.37		
	98.10		
	7.93		
	67.41		
	95.00		

The tailing from the West mill is taken periodically by the railroad company for use as ballast, as shown in the accompanying photograph. In order to find room for the tailing discharged from this mill, it has been found necessary to elevate this residue 25 ft. This is done by means of a 12-in. Byron Jackson centrifugal pump connected directly to a 75-hp. 2300-volt motor making 900 r.p.m. This pump discharges into a sump, 6 ft. square and 6 ft. deep, from which the tailing is carried 600 ft. in a 36-in. launder. The normal performance of this little plant is 600 dry tons of tailing per day and 4000 gal. of water per minute. The co-ordination of the pumping with the diluting of the discharge is effected by an ingenious device, the credit for which is due to Ed. Hearing, the mill foreman, to whom the company is indebted for many clever contrivances. The device consists of a steel umbrella supported upon the vertical column of water as it is discharged by the pump. Surmounting this umbrella is a steel rod to which is attached an electric rolling-contact on a spring. On the side of a wooden box surrounding this mechanism is a carbon electrode connected with the no-voltage release that stops the motor actuating the pump. Whenever the water-column drops to a point where there is not sufficient water to carry the tailing along the launder, the rolling contact meets the carbon electrode and stops the pump. The feed to the pump is then automatically diverted to a flume provided for the purpose.

The success of the effort to improve the beneficiation of the product of the mine is proved by the fact that the economic extraction, that is, the ratio of the gross market-value of the metals in the mill-feed to the net value of the concentrate after deducting the charges for freight and smelting, has been increased from 34% in 1909 to 55% in 1919. In June 1919, for example, the feed assayed 10.05% lead and 3.9 oz. silver; the mill product averaged 42.64% in lead and 15 oz. in silver per ton; the average assay of the concentrate was 68% lead and 23.8 oz. silver; the middling assayed 10.79% lead and 3.88 oz. silver (or about the same as the original feed); the economic extraction was 55.8%.

The ore is usually regarded as simple, on account of the absence of zinc, but as a matter of fact to the millman the presence of siderite creates a problem quite as difficult; to him the ore consists of argentiferous galena in a siderite gangue, associated with a minor proportion of pyrite and an almost negligible amount of blende. An important factor in the milling is the intimate penetration of the siderite by the galena, the minute threads of the lead mineral penetrating the siderite so as to call for grinding below 150-mesh in order to liberate the galena.

In conversation with Mr. Handy I found him to be an advocate of leaching. He suggested, for instance, that instead of using flotation for the slime, it would be well to roast the galena, as can be done cheaply without undue refinement of method, and follow this by leaching of the sulphate in a solution of brine, which is cheap, and subsequent precipitation of the lead by means of lime or the electrolytic current.



SPECIMENS OF ASBESTOS

Asbestos, A Canadian Specialty

By F. C. C. LYNCH

In Roman times the lamp-wick that was not consumed, and the cloth that would not burn were rare curiosities. Today thousands of tons of a mineral fibre superior to the Roman product is used for these and many other essential purposes in industrial and domestic life. A fibre, incombustible and indifferent to fire, time, and weather, a poor conductor of heat and electricity, enduring, and yet capable of being spun into threads of considerable strength and woven into cloth must be of great economic importance, of course. This fibre is asbestos, a Canadian specialty.

It has been found in almost every quarter of the globe, but nowhere of better quality than in the Eastern Townships of Quebec, Canada. In all but one or two cases the quality of that found elsewhere is distinctly inferior and it seldom occurs in paying quantities. Where asbestos of good quality has been found, as in Russia and South Africa, an unfavorable location as regards transportation has made it impossible for it to compete on favorable terms with the Canadian product. Before the War Canada produced 87% of the world's supply of this mineral. With Russia for the present out of the field, Canada's predominant position is obvious. And yet the productive area is small. Although the occurrence of asbestos has been reported and some has been mined in other parts of Canada, nearly all of it comes from this limited area in Quebec. The principal centre of the industry is Thetford in the county of Megantic.

The name asbestos, as commercially applied, covers two distinct minerals, which have, in common, a fibrous structure with both fire and acid-proof qualities. These min-

erals are hornblende-asbestos and serpentine-asbestos, or chrysotile. The heat-resisting qualities of both are approximately the same, but the hornblende variety does not generally possess the same silky quality as the chrysotile; consequently, when strength of fibre, as well as non-conductivity of heat are required, chrysotile only can be used. All the Canadian asbestos is of the latter kind. The essentials that render asbestos of economic value are length, fineness, and elasticity of fibre, tensile strength, and power of resistance to fire. The Canadian chrysotile possesses all these qualities, the length of fibre being one of the principal factors governing its grading.

It has a pearly lustre and although it varies in color from deep green to yellow, yet when drawn out in threads it is white with a silky lustre. It also exhibits extreme delicacy and silkiness to the touch, with great adaptability for spinning, although for a time the fibre produced from asbestos resisted all attempts in this direction. The difficulty arose from its peculiar formation, which, possessing smooth surfaces (unlike wool and silk, whose fibres bear teeth-like projections or imbrications), and being much less flexible than those of organic origin, slipped past each other when subjected to the spinning process. But all these difficulties have been overcome. A single thread of appreciable tensile strength can now be made, weighing not more than an ounce per hundred yards. Temperatures of 2000° to 3000°F. are easily withstood, while on some varieties a temperature of 5000°F. has produced no visible effect.

As to the fibres themselves, microscopical investigations show that each apparently single thread is com-

posed of exceedingly fine filaments, the most minute numbering up to 25,000 per linear inch. The main differences discernible between hornblende-asbestos fibre and that of chrysotile, such as the Canadian product, are the more finely divided nature of the latter and the more glassy rod-like appearance of the former.

*"The study of the geological conditions of the district has now fairly well established the fact that the serpentine of the Eastern Townships (the mother-rock of chrysotile-asbestos) is a secondary rock. It is the alteration product of olivine, a rock of igneous origin. It can be conclusively shown that in nearly all cases this anhydrous olivine was changed gradually into serpentine, or a hydrous silicate of magnesia, and that subsequently, through the action of certain agencies, fissures were formed and filled with an asbestos-bearing solution, which gave rise to the ultimate crystallization of the fibre." It would appear that these asbestos-filled fissures were caused by the shrinkage of the serpentine and also by the injection of the granite dikes that are found throughout this area. This would account for the reticulation of these veins and the way in which they vary in size, and also for the fact that they are found to be numerous near these dikes. It is obvious that all these changes took place very slowly and not only on the surface but at depth.

There are two areas in the Eastern Townships producing asbestos—the Thetford, Black Lake, and the Danville, the first district being by far the more important. Large portions of these areas do not, however, contain asbestos in paying quantities. The veins occur in the serpentine, as indicated above, without any special arrangement, intersecting each other and the rock generally in every direction. Their thickness varies from a few threads to several inches. The bulk of the fibre recovered is, however, between a quarter and a half inch in length.

The transportation facilities are excellent; no mining camp in North America can compare in that respect with the Canadian asbestos quarries. It so happens that the productive belt follows closely the winding course of the railway built before the asbestos mines were discovered. No quarries are more than a mile and a half from the track. Moreover Thetford is only 75 miles from Quebec, whence the asbestos may be shipped to Europe, and 350 miles from Boston.

The area in which serpentine is found in paying quantities in this district is computed at not less than 15,000 acres. Numerous bore-holes have been made and it has invariably been found at the greatest depths reached. Many hundreds of feet below the present working levels the character of the rock remains unchanged. Owing to the way in which the veins branch and vary in width and number it is impossible to get a good idea of the extent of the deposits by boring or by sinking shafts. However, since asbestos has been found at 700 ft. and since the deposits of asbestos do not vary in extent or

quality as the quarries increase in depth, it may be estimated that there are millions of tons of fibre and that the industry will have a long life.

Although asbestos was known to the Romans and although Marco Polo, in his travels through Siberia in the 13th century, was shown it there, little use was made of this mineral until about sixty years ago. About this time attempts were made to exploit the deposits in the Italian Alps, and almost simultaneously asbestos was discovered in the Province of Quebec. In 1862 a specimen of fine silky-fibred asbestos from this Province was exhibited in London. But it was not until 1878 that mining operations were begun following the discovery of asbestos in 1877 near Thetford.

The industry rapidly expanded and in 1885 seven quarries were in operation with a production of about 1400 tons of fibre per year. From this date an increase of price resulted in exploitation on a larger scale and dividends up to 22½% were declared by some companies. But this state of affairs did not last long. Prices began to drop, the demand slackened, and in the middle of the 'nineties many quarries were forced to close down, and the industry received a severe set-back.

For some years production languished, but the result was really beneficial. Previously the ore had been treated by hand, with the result that all the smaller fibre was discarded. Then mechanical treatment of the ore was devised, and the industry rapidly re-gained its feet. Uses have been found for all the fibre, even to asbestic sand, and the demand is now so great that the asbestos industry is one of the most flourishing and prosperous in Canada. The production in 1918 was 142,375 tons, the greatest output ever recorded. The value was over nine million dollars. In 1919 the industry was equally prosperous, having suffered no post-war depression.

Owing to the fact that the Canadian deposits occur on the surface the ore was first obtained by quarrying. This is still the general method, chiefly because of the uncertain way in which the veins reticulate and vary in thickness and number. However, this entails certain disadvantages: the removal of waste from barren zones; the exposure of the workmen to inclement weather, which sometimes interrupts operation; and extra expense for drying the ore, which often becomes wet through exposure to snow and rain. All these are serious items. The disadvantages of underground mining are difficulties in supervision and ventilation, costly timbering, and loss of asbestos in pillars. At present the tendency seems to be toward providing underground work for inclement weather, but to retain open quarrying for the remainder of the year.

The rock is drilled, chiefly by compressed air or by electric drills, blasted by dynamite, and then treated according to the grade of the material. The very highest quality of asbestos, the long fibre known as 'crude', is 'hand cobbled', that is to say, the adhering rock is separated from the fibre by hand hammer. This quality represents about 4% of the whole production of asbestos. The rest of the rock is conveyed to the nearby mills where

*'Chrysotile-Asbestos', second edition 1910, by Fritz Crikel. Mines Branch, Ottawa.



BELL'S PIT, THETFORD MINE

ANOTHER VIEW OF SAME

it is crushed, dried, re-crushed, screened, and pulverized in 'cyclones' where rapidly whirling helical screws throw the pieces violently against each other and thus loosen the fibre, which is afterward removed by suction fans and re-graded.

Manufactures of asbestos in Canada are almost wholly confined to the use of the shorter fibres and asbestos sand. The latter is used for fireproof plaster and fireproof paint, while the former is used chiefly in the manufacture of asbestos slate and shingles. These are made of asbestos fibre embedded cross-wise in cement-paste and subjected to heavy pressure. In this way thin sheets are formed having extremely high physical strength, indifference to blow and shock, and great elasticity, properties which are of as great importance in the conveyance and laying of shingles, as is durability. After three months' exposure the asbestos-cement slate becomes impervious to water, indestructible, and as hard as iron. This product may be colored as desired. It may also be used in large sheets in building construction. The future of this industry is very promising and would appear to depend very largely on the price of cement.

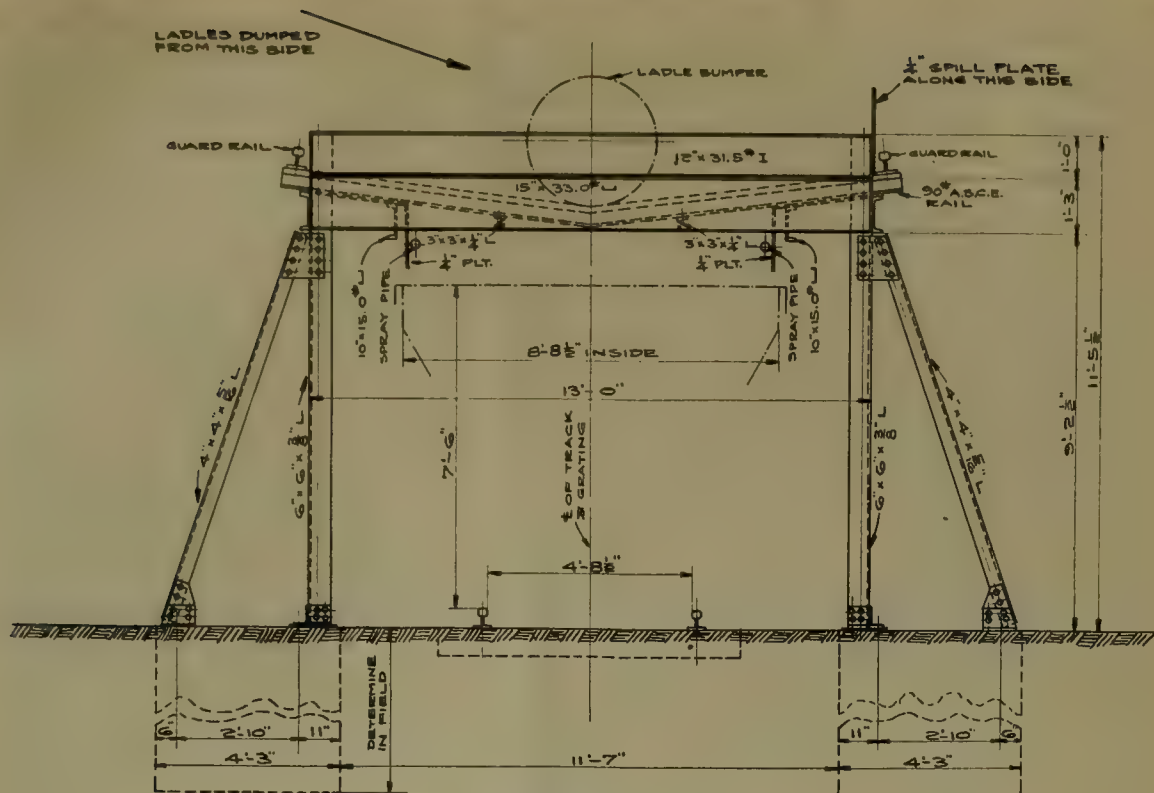
Other articles manufactured from asbestos are made chiefly in the United States and in Europe. Among these are-cloth, spun and woven from pure asbestos fibre, and used for safety drop curtains in theatres, for theatrical scenery, and for clothing for firemen, and asbestos sewing-twine and rope. A one-inch rope weighing 40 lb. per 100 ft. will carry safely a load of 500 lb. Asbestos-paper and mill board are being extensively used in building construction. They are fireproof and are poor conductors of heat and sound waves. The fibre is also used for steam-packing for valves and cylinders, being the only permanent elastic and generally satisfactory material available for the purpose, especially for use with super-heated steam at high pressure. Still other articles are asbestos-wood which, though fireproof, is capable of being turned and grained and taking a high polish, asbestos-tile for flooring, asbestos-covered metal, filters,

asbestos-leather, non-burn brake-linings, and kitchen utensils. In fact the uses to which this mineral may profitably be put are almost innumerable.

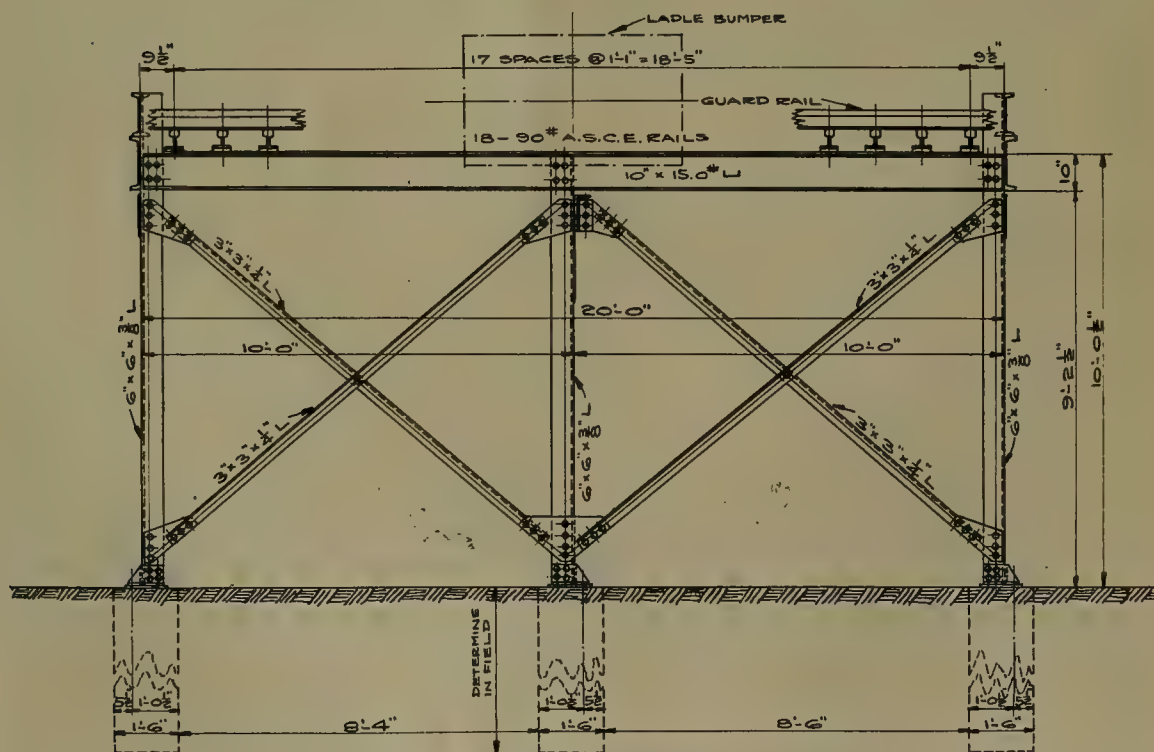
The production of Canadian asbestos has increased very greatly during the past four years and the average price in 1918 was from three to four times that of 1914, so it is evident that the demand still exceeds the supply. Before the War the United States took about one-half of Canada's production, but demand from Europe was growing more rapidly. Now, however, the United States is taking nearly three-quarters of the supply. With the recovery of Europe it may be confidently expected that the European demand will revive, especially for the shorter fibres used in building construction. As these fibres constitute the bulk of the production and have formerly been produced in excess, it is apparent that the Canadian asbestos industry has a prosperous future.

Canada herself is importing from the United States an increasing amount of manufactured Canadian asbestos. It is obvious, and but natural, that she should wish to manufacture these goods at home, and in the not distant future there may be built up in Canada large asbestos-manufacturing industries able to supply the world with the finished product.

CONSIDERABLE ATTENTION has lately been attracted to Trinidad in connection with the boom in oil throughout the world. The shares of companies listed in London and interested in oil developments in Trinidad have lately had spectacular advances, and there seems now a rapid movement to organize new companies to drill for petroleum on the island. The leading companies already seem determined on a policy of further expansion, and in their keen competition for the purchase of lands thought to be oil-bearing, the prices have lately been as high as \$500 per acre, where indications seemed especially favorable; this applies only to private lands, as all Crown or Government lands in the mineral-oil districts have been covered long since by concessions to British companies.



END ELEVATION



SIDE ELEVATION
SIDE BRACES NOT SHOWN

Concrete Mine-Bulkhead

*A reinforced concrete dam was constructed in the 3-19 raise at No. 1 shaft of the Modderfontein East mine, for the purpose of controlling and closing off a flow of water which yielded approximately one million gallons per day at a pressure of 500 lb. per square inch. This stream was cut in the dike through which the raise was being driven, and was found to be coming from a vertical fissure striking north and south. This fissure was found to be filled to a large extent with soft clay, which was not sufficiently solid to resist removal by the water under pressure, with the consequence that as soon as the water was tapped in small quantity a portion of the clay filling was quickly washed out, and, furthermore, the dike material adjacent to the fissure, being of a broken and loose nature, was displaced by the flow until a cavity about 18 in. wide, 6 to 10 ft. long, and 10 to 15 ft. high was created at one corner of the face.

Fortunately the dam was constructed and finished before this continuous stripping action was able to extend across the whole width of the face, thereby preventing a further increased flow of water. A good concrete, consisting of 1 part cement, 1 part sand, and 2 parts broken stone, was rammed into the face to a thickness of approximately four feet. No hitches for support were cut in the rock, but a series of 40 one-inch steel pegs were driven to a depth of 6 to 9 in. into the rock in two rows around the perimeter of the drive; these pegs projecting a distance of about 1½ ft. into the mass of concrete. In addition to this, two rows of ½-in. bar-iron, one vertical and one horizontal, the bars being about one foot apart, were embedded in the concrete during construction and tied by means of wire to the above-mentioned pegs, thereby forming a double grille system of reinforcement. In this way a thoroughly strong wall was obtained.

The feeder of water was confined behind the concrete to as small a channel as possible with the aid of 21-gauge steel sheets, and released through two 6-in. pipes fitted with stop-valves. By this means it was possible to place the concrete in position correctly without any interference from the water. Six 1½-in. cementation pipes were also built in the dam for the purpose of filling and solidifying the fissure and the subsequent testing of the ground in advance. While this work was in progress three release holes were drilled into the hanging wall from the front of the dam at an angle of 45°, thereby intersecting the fissure approximately 12 ft. above the back of the raise. Injection was then started on August 19, and continued until August 27, when all the pipes in the dam had been solidly closed with cement, and also two of the release holes in the hanging wall. At this stage approximately half the original feeder was shut off, but, owing to shortage of cement, it was not deemed advisable to close it all off. Sufficient cement was obtained on September 1, and injection continued for two days, when all the release holes in the hanging wall were completely

finished, thus effectively shutting off all water. Four tons 14 cwt. of cement was used in the concrete construction; 25 tons of cement was injected at pressures ranging from 25 to 220 lb. per square inch, giving a total quantity of 30 tons of cement used for closing off this fissure. After completing the dam and shutting off the water, the mode of procedure consists of testing the ground in advance by means of bore-holes, and, if additional water-bearing fissures are cut, cementation is conducted, so that the drive may subsequently be extended through the water zone without encountering water, the ferro-concrete dam being in the first place removed by blasting.

Platinum in British Columbia

The following notes on platinum are from J. B. Hobson, the manager of the Consolidated Cariboo hydraulic mine, situated in the Quesnel district in British Columbia: For several years, qualitative tests have been made from time to time for the presence of gold, platinum, and osmiridium in the heavy concentrates that remain in the sluices after cleaning up; and while making one of these tests in May 1903, the presence of palladium was indicated in addition to platinum and osmiridium. An analysis of a sample of concentrates, made by J. O'Sullivan, chemist, of Vancouver, in May 1903, gave large quantities of gold, platinum, palladium, and osmiridium, which brought the value of the concentrate up to \$3873 per ton. A second sample taken from a pan of concentrate taken from the sluices after the clean-up in September 1904, was sent to Mr. O'Sullivan and gave the following results:

	Ounces per ton	Value per ton
Gold	95	\$1900.00
Silver	180	90.00
Platinum	64	832.00
Palladium	64.4	1769.00
Osmiridium	42	1386.00
Copper, per cent.....	10.5	16.56
Total value		\$5993.56

The gold and silver are, no doubt, included in particles of pyrite and argentiferous galena, and partly in small particles of gold covered by manganese and other metallic oxides, and cannot be recovered by the process of amalgamation. The platinum, palladium, and osmiridium are found in minute metallic grains and enclosed in small fragments and nuggets of magnetite and chromite, which appear to make up quite a large part of the sluice-concentrate found after cleaning up. What quantity of this high-grade concentrate is included in the deposits, or can be recovered therefrom, cannot be determined until after the completion of the system of undercurrents which is to be placed at the end of the sluice outside the tunnel, where everything of value will be separated from the tailing, before going over into the dump, and concentrated on the undercurrent tables. These undercurrents will probably be completed before the close of the ensuing season.

*Abstract of a paper by Thomas Blandford in the Journal of the S. A. I. E.

Operations of the Nevada Wonder Mining Company During Four Years of War

By E. E. CARPENTER

The World War caused various fluctuations in the operating costs and profits of silver mines in the Western States, as a result of the increased cost of labor and materials and the coincidental rise in the price of silver. The effect on net profits is shown in the information available in the reports of operations during recent years of the Nevada Wonder Mining Co., from which sundry interesting comparisons may be made.

The production of silver from this mine decreased gradually from 1915 to 1919 in consequence of the depletion of the ore-reserves and the necessity for treating ore of lower silver content. The higher price of silver offset the increased costs and permitted this lower-grade ore to be worked at a profit. Had it been possible for the mine to continue producing ore averaging 20.84 oz. silver and 0.176 oz. gold—the tenor of 58,124 tons treated in 1915—the enhanced price for silver would have enabled the payment of greatly increased dividends. Like the great majority of silver orebodies, however, this one had been bottomed at a comparatively shallow depth. The stopes in the immediate vicinity of the Nevada Wonder shaft produced only a small tonnage below the 600-ft. level, although the Extension orebody was continuous for 1000 ft., from the 300 to the 1300-ft. level of the Nevada Wonder shaft; the former corresponding to a depth of 100 ft. from the outcrop of the lode, thus giving the orebody a vertical depth of 1100 ft. from the surface. However, it is fair to mention that over two-thirds of the bullion was derived from ore that was mined within approximately 500 ft. of the outcrop.

During the year 1918 the company treated 49,710 tons of ore for a total net operating profit of \$179,548, equivalent to \$3.61 per ton. The average content was 0.103 oz. gold and 13.23 oz. silver per ton, showing a decrease of 0.038 oz. in gold and 3.42 oz. in silver as compared with the preceding year. The average price for all the silver sold was \$0.966 per ounce. Table No. 1 affords a comparison of the metal content and value of the ore produced from 1915 to 1918 inclusive. The gold content decreased gradually, showing a total decline of 41.5%, while the silver content decreased 36.5%. The value of silver increased from a nominal quotation of 50 to 96.6 cents per ounce, or 93.2%. The ore treated in 1918 would have had a value of only \$8.75 if mined during 1915, as compared with the actual realized value of \$14.93.

Table No. 1—Content and Value of Ore

Year	Gold oz.	Silver oz.	Value per ton	Average price of silver
1915	0.176	20.84	\$13.97	\$0.500
1916	0.159	18.72	15.40	0.647
1917	0.141	16.65	16.65	0.817
1918	0.103	13.23	14.93	0.966

Having compared the contents and value of the ore during this period of four years, it will now be useful to compare all the costs in connection with the mining and milling operations. Table No. 2 compares the direct, indirect, and total mining costs. The tonnage treated each year did not vary sufficiently to account for any considerable variation in costs, which must therefore be attributed to changing labor and market conditions. The lower direct cost for 1918 as compared with 1917 was caused by a decrease in development work, which was discontinued largely both downward and laterally, after the vein had been explored for 4500 ft. along its course and to a depth of 2000 ft. Had it not been for this change in policy about the middle of the year, the cost for 1918 would have been greater than for any preceding year. The average amount of development work during this four-year period was approximately 750 ft. per month.

Table No. 2—Mining Costs

	1915	1916	1917	1918
Direct cost	\$3.33	\$4.46	\$5.41	\$4.48
Indirect cost	0.83	0.83	0.97	1.04
Total cost	\$4.16	\$5.29	\$6.38	\$5.52
Average cost per foot of development work	\$7.70	\$9.31	\$11.05	\$11.65

Note: Transportation to mill was not included.

The direct per-ton cost of mining was divided as follows:

Table No. 3—Mining Cost, Segregated

Year	Labor	Supplies	Explosives	Power	Total
1916	\$2.986	\$0.713	\$0.569	\$0.212	\$4.46
1917	3.587	0.990	0.580	0.254	5.41
1918	2.997	0.699	0.511	0.271	4.48

The corresponding direct cost for milling is shown in the following table divided under the three headings: labor, supplies, and power.

Table No. 4—Milling Cost, Segregated

	Labor	Supplies	Power	Total
1915	\$0.705	\$1.166	\$0.394	\$2.265
1916	0.753	1.641	0.367	2.761
1917	1.052	2.031	0.435	3.518
1918	1.108	2.002	0.482	3.592

Table No. 5—Combined Mining and Milling Costs and Profits

	1915	1916	1917	1918
Total mining cost per ton, including transportation	\$4.19	\$5.33	\$6.43	\$5.58
Total milling cost per ton	2.81	3.31	4.12	4.26
Marketing cost per ton	0.27	0.26	0.23	0.25
Total cost per ton	\$7.27	\$8.90	\$10.78	\$10.09
Average value per ton	\$13.97	\$15.40	\$16.65	\$14.93
Loss in tailing per ton	0.82	1.13	1.80	1.22
Recovery per ton	\$13.15	\$14.27	\$14.75	\$13.71
Less total cost per ton	7.27	8.90	10.78	10.09
Profit per ton mined and milled	\$5.88	\$5.37	\$3.97	\$3.62

Note: The high loss in tailing in 1917 was caused by treating sulphide ore before concentrators had been secured.

Table No. 5 shows the total mining and milling costs, direct and indirect, cost of transportation to mill, mar-

keting, taxes, and depreciation; in fact, all charges properly made on mining account. The average value of the ore, loss in tailing, recovery, and the all-important item of profit-per-ton of ore treated, are also shown.

An effort to show the increased cost of producing an ounce of silver led to the compilation of Table No. 6. The ratio of gold to silver remained fairly constant, so the value of all gold produced each year was deducted from the total cost for the corresponding year; the then remaining cost of operation represented the cost of producing the silver. Dividing this cost by the number of ounces produced gives the figures, under the caption 'cost per ounce of silver after deducting the value of gold', which show a gradual increase from 18.2 to 64.6 cents.

ticularly desirable. The quality of adhesion and elasticity is easily proved by applying a $\frac{1}{2}$ -in. layer to a 1-in. board which first has been covered with metal-lath. Such a board, about 8 ft. long, may be repeatedly deflected 3 in. in the centre without breaking the bond to the board or causing any cracks to appear in the magnesia cement. The ability to resist fire as well as the possession of insulating qualities are also desirable characteristics of magnesia cement.

Magnesite cement should be applied in two coats, each $\frac{1}{4}$ in. thick, on various surfaces such as wood-lath, metal-lath, sheathing-board, brick, hollow tile, or stone. Care should be taken if lime is present, unless this has been rendered, or has become inert, as with very old walls. The first coat is made to a consistence that works easily

Table No. 6—Summary of Cost of Producing Silver

Year	Gold, oz.	Silver, oz.	Value of gold	Value of silver	Total cost	Cost per ounce of silver					Average price of silver	Tons milled
						Total cost less value of gold	after deduct- ing value of gold	Recovery per ton Gold	Silver			
1915	9,500	1,123,398	202,612	561,700	407,182	204,570	0.182	0.169	19.30	0.500	58,124	
*1916	10,933	1,243,753	226,006	805,237	624,576	398,570	0.320	0.151	17.20	0.648	72,241	
1917	7,513	816,853	155,255	667,685	588,913	433,658	0.539	0.135	14.64	0.817	55,800	
1918	4,877	601,665	100,444	581,165	489,044	388,600	0.646	0.098	12.10	0.966	49,710	
*15 months.												

*15 months.

These figures, of course, apply to one particular mine, which unfortunately faced a gradual decrease in the grade of ore treated during the four years considered. It is a fact, however, that a number of other silver mines in Nevada were working under similar conditions.

Magnesia Cement to Protect Mine-Timbers

By W. C. PHALEN

*For mines that are situated in out of the way places, where timber is scarce and its price high, the problem of protecting it from fire is important. Scarcity of timber for mining purposes commonly exists in the more arid parts of the country, where, also, mine-timber is most likely to become dry and inflammable, and where, therefore, the risk from fire is accentuated. Any effective and cheap method of securing adequate protection of such timber at the lowest possible cost is worthy of careful investigation. The use of magnesite cement has been suggested in this connection.

The necessary qualities for any substance for this use may be summarized as follows: It should be resistant to abrasion, to impact, and to structural stresses. It should be durable when subjected to the action of the elements, and stable to any minor derangements of the base on which it is placed. It must be relatively unaffected by changes in temperature, or by the action of water, and should adhere to the material on which it is placed; and it should also be free from shrinkage cracks due to setting of the material.

Magnesite cement appears to fulfil these conditions. Its elasticity is the outstanding quality that makes it par-

under the trowel, and is applied in the usual manner. No water should be added to the liquid chloride as it would alter its density, and injure the work. The second or finishing coat is then applied. The aggregates are different in each, and no other dry material should be added to them as they come to the trade. The cement may be applied in zero weather without damage. Setting is quite slow under such conditions, but it ultimately becomes hard. It should always be applied to a dry surface except that under certain conditions it is desirable to apply a solution of magnesium chloride first.

The temperature is of importance. If the temperature is over 50°F., only so much of the first coat should be applied in one day as can be covered with the second coat. In this way, the finishing coat is applied before the first coat has become hard. If the temperature is below 50°F., the finishing coat can be applied 24 hours after the first coat is applied.

Abundant supplies of magnesite occur in California and Washington, in close proximity to regions of large mining operations. The cost of transportation of such material would, therefore, be correspondingly reduced. Magnesium chloride is also an essential ingredient in making magnesia cement. Supplies of by-product magnesium chloride, produced in connection with the solar evaporation of salt along the Pacific Coast, have been largely wasted heretofore. Any development of a magnesia cement industry on the Pacific Coast ought to stimulate greatly the conservation of this chloride as well as the demand for Western magnesite, if the suggested use for magnesia cement is found practicable. Such use should also tend to place Western magnesite on a more secure basis by enlarging what is peculiarly a domestic application, and in which, moreover, there would be little danger of serious foreign competition.

*From Reports of Investigations, Bureau of Mines.

Hanging-Wall Support on the Far East Rand

By L. W. MACER

*The problem of the support of the hanging wall in the deeper mines of the Far East Rand has engaged the attention of the mining men concerned for some time past. The objects of these notes are, firstly, to place the problem before those engineers who, not being conversant with East Rand mining, may have been faced on other fields with similar conditions, and, secondly, to bring forward suggestions for the utilization of waste material, such as old ropes and pipes, in the construction of roof supports.

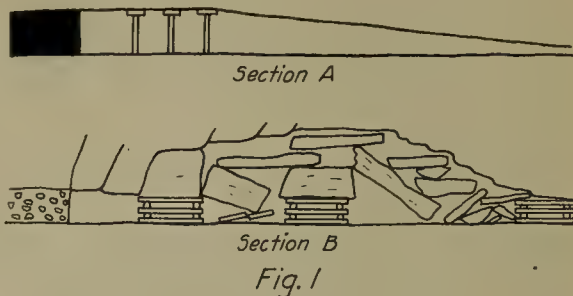
An opinion has been widely held that the panacea for hanging-wall trouble in flat mines lay in the adoption of colliery practice, but to the writer, and to others who have come to the East Rand with coal-mining experience, it has become apparent that to deal with a colliery roof is an entirely different proposition from the support of an East Rand hanging wall. The difference is best explained diagrammatically. In Fig. 1, *A* represents a section of a longwall face, and *B* a flat stope face where hanging-wall trouble has become acute. The forces acting and the direction of those forces are precisely similar in both cases, yet the effects are very different. The hanging in *A* has subsided in a gradual manner, its surface approximating a curve from the coal face to the filling, whereas in *B* cracks have developed at and parallel to the face, and the hanging throughout the stope has broken up and has none of its original stability. The result is the development of a danger zone between the last support and the face, which means that work has to be carried on in a veritable death trap, while in coal mining perhaps the safest place in the mine is at a systematically propped longwall face.

The reasons for the difference in the conditions of the hanging wall are:

- (a) The difference in the relative rates at which the faces of the coal and the vein are worked.
- (b) The initial resistance of the supports used in the different classes of mining.

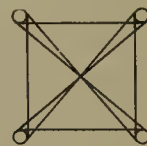
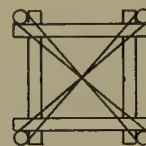
The difference in the rate of advance of a stope face and a longwall face is, of course, considerable. A stope face equipped with machines breaking one fathom per machine shift will only advance about 12 ft. per month, the general average for a mine being much less than this, while a longwall coal face equipped with disc coal-cutters and mechanical conveyors will advance the depth of their cut, namely, 4 ft. 6 in. to 5 ft. per 24 hours. To the relatively slow advance of a stope face, I attribute the difference in stability of roofs, although the heavy blasting and sometimes indiscreet placing of holes in stoping, no doubt, is contributory to the effect.

Coming to the second reason, it is observed that the props used in longwall systematic timbering have a considerable initial resistance, while cribs used in stoping have practically no initial resistance; in fact their maximum resistance is not reached until they become compressed by about 20% of their original height. This amount of compression is observed at varying, but generally at considerable, distances from the face. The hang-



ing wall is therefore supported at two points, namely, at the point in the stope where the cribs have reached their maximum resistance, and at the face. It therefore follows that fracture may be expected at and parallel to the face or in proximity to any pillar left in the stope. Practically, we have the phenomenon of 'punching'.

The comments to be expected upon the above statements will no doubt be that there is no originality in



them; secondly, that stope faces cannot be advanced more rapidly; thirdly, that props, notwithstanding their initial strength, are impracticable in deep-level flat mines; and, finally, that as a cure seems impossible the trouble must be endured. The difficulties above outlined have been recognized, and steps have been taken to combat them; the remaining remarks refer to such improvements as have been already adopted and suggestions for further improvements.

IMPROVED SUPPORTS AND METHODS. An increase in initial resistance of cribbing has been to a certain extent effected by driving wedges into the split ends of the lagging of which the crib is built. This method is not so effective as might be supposed, and an improved method of wedging without splitting the sticks has been introduced. A split stick (half-round) is placed flat side

*Reprinted from the Journal of the Chemical, Metallurgical & Mining Society of South Africa.

down in about the centre of the crib. A long wedge of small taper is driven in below the split lagging and rests in a square joggle in the next underlying stick. By driving home these long wedges the whole of the upper portion of the crib is forced up to the hanging.

Well built dry masonry has been used in preference to cribbing. A pack 20 ft. square with rounded corners is used. These packs, in addition to giving a good initial resistance, resist blasting better than cribbing. They are built by experienced masons, and the cost appears to be rather higher than for building cribs. The masons at 20s.* per day handle about three tons of stone, which does not, however, compare favorably with a surface mason's day's work of two and a half cubic yards.

The use of pillars in conjunction with the above mentioned supports is the generally recognized practice, notwithstanding that even the greatest advocate of the pillar admits its disadvantages. In deep-level mining it is difficult to demonstrate the utility of the pillar except under special circumstances, such as the support of faulted ground or in the process of the reduction of stoping widths.

A method, comparatively recently introduced, known as the 'Panel System', makes use of pillars regularly placed and subsequently removed. It approximates the pillar and stall method in colliery work, the stalls being from 70 ft. to 120 ft. wide with pillars of 30 ft. It is undoubtedly the best method of controlling roof weight in a stope where the face advances slowly, and it effectually obviates the dangerous condition mentioned in the earlier portion of this paper.

The crib has the great advantage over masonry in cost of construction, as comparatively unskilled labor can be used. It has the disadvantage of being easily damaged by blasting unless it is carefully built and unless the stope timberman and machine man work amicably, a condition which it is difficult to obtain in practice.

Fig. 3 illustrates a design that should allow of good construction by an indifferent workman and should result in a crib that it would be difficult to blast out. Four posts are set in such a manner that the ends of the horizontal sticks do not project beyond them. Old wire rope is then passed round the posts as shown in the figure. These ropes are drawn as taut as possible, and finally tightened by means of twisting by the insertion of a piece of pipe or jumper at the point A. The frame is then filled with stone.

Fig. 4 shows a similar construction, but using wire rope in place of the horizontal sticks.

Fig. 2 uses old pipe filled with concrete for the posts. A plug of wood is used in the upper ends of these posts and answers two purposes: it allows a certain amount of compression, and can be easily sawn to adapt the length of the post to the height of the stope. Wire rope is again used as in Fig. 4.

In conclusion, it may be mentioned that the question of the support of roof in the East Rand mines would be much more acute if it were not for the fact that owing to

unpayability, almost half the area remains unmined. As more mines become worked, however, the roof must become more troublesome and the lay-out of underground workings and methods of mining that have been more or less satisfactory in the past will in all probability be found wanting in the future.

In the discussion following the reading of this paper the following comments were made:

By J. Chilton: "The subject of hanging-wall support is interesting to all men who go down to the mines, and although the East Rand district has not really reached its troubles yet, still the time will come, and a new method of support may have to be invented for the flat mines of that district.

"Mr. Macer speaks of leaving temporary pillars. Some of us in the central area have had a good deal of experience with pillars, and the general opinion is that rigid supports are not only a danger to the persons working round about, but are also a danger to surface property. Almost every earth-tremor, and these are numerous, is caused by the bursting of pillars, and where this does occur the punching effect causes falls of hanging that otherwise would not occur. To my mind, the leaving of pillars is a mistake, apart from the expense of cutting them, and cribbing forms the ideal support for hanging walls.

"It is encouraging to know that the mining people of the East Rand are taking up the idea of roof support and that they are evolving new forms. The cribs mentioned by Mr. Macer, and which are I believe his own invention, are novel in construction and are probably effective; but of new forms of this support there is no end, each probably limited in its application to the particular mine where designed."

By J. Gibson: "To those of us who are engaged in mining operations, this is a most important subject, and one which has lent itself to numerous discussions, which have probably brought about a good deal of improved practice in supporting the workings in the mines. The question of leaving pillars for support has been a vexed one, and in the Central Rand area has been the cause of many serious bursts. Generally speaking, the practice is to support the hanging wall by less rigid methods than the leaving of solid pillars. This method has been advocated time and again by different members, and where it has been practised I think it has led to a reduction in serious accidents and probably better mining."

THE USE OF SLATE for roofing is apparently on the decline, although a part of the falling off in production in recent years is due to war-time curtailment of building, according to a report recently issued by the U. S. Geological Survey. The major part of the slate produced in this country is, contrary to the general impression, used on the inside rather than the outside of buildings, for such purposes as making stationary washtubs, electrical switchboards, and blackboards, and the output for these purposes has been practically uniform for the last twelve years.

*\$3.75 at present rate of exchange.—Editor.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

VERDE M. & M. CO. STARTS ITS MILL.

HUMBOLDT.—The Blue and DeSota mines of the Consolidated Arizona Smelting Co. shipped 13,400 tons of ore in February. The mill handled 8850 tons of ore and the smelter treated 8150 tons. Part of the ore treated was of foreign origin. 910,000 lb. of copper was shipped to Eastern refiners.

JEROME.—The Verde Mines & Milling Co., whose property is situated seven miles south of Jerome and was formerly owned by the Monarch company, commenced milling on March 18. The ore now being treated is said to run \$25 per ton in gold and is largely free-milling. Part of the ore will be cyanided in a 30-ton cyanide annex on the property. Since operations were com-

menced by the new company in January, the mill has been remodeled, new buildings erected, a five-mile road re-built, 5500 ft. of water-line laid, and the underground workings cleaned out and re-timbered. Development has opened new ore.

Operations at the Jerome-Superior mine are progressing rapidly. A new steam-driven compressor has been installed and another big pump is to be placed on the 700-ft. level. A three-inch pipe-line, 3000 ft. long, for handling fuel-oil has been laid from the V. T. & S. railroad. Two diamond-drills are operating on the 700-ft. level. A flat hole is being run westward and another hole from the east cross-cut has advanced 115 ft. Development on the 700-ft. level has proved the existence of a large body of schist and a well-defined contact. The shaft is now down 750 feet.

KINGMAN.—An attempt by minority stockholders to stop the sale of treasury stock by the Schuyllkill Mining Co. to a New York company has been defeated by the decision of Judge Bollinger of the Superior Court.

PHOENIX.—It is reported that the Eyrich Gold Mines Co., whose mine is 18 miles north of Phoenix in the Winifred district, is building a 15-ton Nissen-stamp mill. The shaft on the property is down 360 ft. and drifting both north and south on the vein has opened ore said to average \$28 per ton in gold.

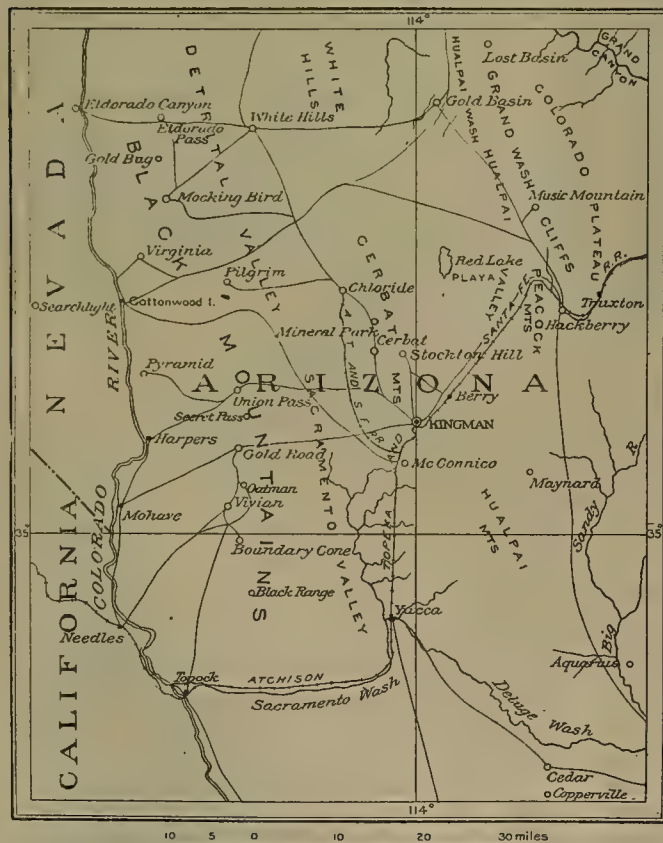
SUPERIOR.—A strike of high-grade ore is reported as having been made on the Chloride group of claims in Russell gulch. The property has been operated for a number of months by William Crawford and associates. A 12-in. vein of ore assaying 34% copper, several hundred ounces silver, and \$3.50 in gold has been opened. It is said that there are several carloads of ore available.

SWANSEA.—It is reported that the Swansea lease is to make extensive exploration on the 600-ft. level. A double-drum hoist has been installed. The mill is treating about 8000 tons of ore per month.

COLORADO

DIVIDENDS FROM CRIPPLE CREEK.

CRIPPLE CREEK.—John W. Sheaffer, Judge of the District Court, this week denied the application of L. T. Gray, claiming interest in the Moffat tunnel property, for a writ of injunction to pre-



MAP OF ARIZONA

Bulletin 397, U. S. Geological Survey

vent connection with the tunnel from the Blue Flag mine workings. The War Eagle Consolidated Mines Co., the Blue Flag Gold Mining Co., the Moffat Tunnel & Transportation Co., and Hildreth Frost, attorney of this city, were named as defendants. It was alleged in the complaint that damage would result "through the filling of the tunnel with bad air" if connection were permitted. The War Eagle company is cross-cutting from its 1200-ft. level of the Blue Flag shaft on Raven hill to connect with the tunnel, in accordance with a contract with the Blue Flag Gold Mining Co., of which corporation Tully Scott of the Supreme Court of Colorado is president. With connection made, ventilation will be afforded to the Blue Flag and War Eagle mines as well as to the tunnel.

The Golden Cycle Mining & Reduction Co. will on April 10 pay the regular monthly dividend of three cents per share, amounting to \$45,000, and it is expected the regular quarterly dividends of the Portland and Vindicator companies will also be paid on the regular dates. The Portland dividend is at the rate of two cents, totaling \$60,000, and the Vindicator dividend, one cent, totaling \$15,000.

Two train loads of ore making a total of 39 broad-gauge cars, containing about 1400 tons, were hauled from the district on March 29 to the Golden Cycle mill at Colorado Springs. The companies contributing shipments were the Cresson, Portland, Vindicator, and Eagle Sampling, and lessees on the Strong, Jerry Johnson, Trail, Star of Bethlehem, and Index mines.

MICHIGAN

WOLVERINE.—MAYFLOWER.

HOUGHTON.—The Wolverine company is not touching its mine-pillars. From the 40th level upward it now is working out the old stopes and getting fairly good ore. The Wolverine production for the month of March was not large, but it will get back to normal in April if present improvement continues. During February there was considerable difficulty at the Wolverine owing to the flow of mine-water from the South Kearsarge. But this trouble has been remedied. When the South Kearsarge water came in the Wolverine had to keep bailers at work much of the time, thus interfering with the production of 'rock'.

There are a good many people in the Lake Superior district who continue to hold their Wolverine stock and who believe that the company has a possibility of expansion. In addition to the fact that the old stopes are by no means exhausted there always is the hope of the development of ore in some of the other amygdaloids. These will be opened by cross-cuts. Work done some years ago in a limited exploration program showed some possibilities that the management now feels justified in developing. Exploration will be carried on east of the shaft. In addition to the cross-cuts some diamond-drill work will be conducted. There are data enough already at hand to warrant the corporation in expending a reasonable sum on such work.

Mayflower's underground exploration at this writing

is showing encouraging results. The bottom of the shaft carries good looking ore in the foot-wall of the vein. The lateral work, that has been going forward from a point 1709 ft. from the surface, is continuing to supply accurate data of the lode exploration. The north-east drift is 160 ft. from the shaft. The first 50 ft. of this distance was through good ore. Then the drift ran into a badly broken area which continued for 70 ft. This was followed by 40 ft. of trap, but the breast is, at this time, in amygdaloid. It will be continued in a north-easterly direction so long as the results warrant. At a point 140 ft. from the shaft the deposit indicated a turn and a cross-cut was run 60 ft. to the south-east.

The cross-cut to the north-west is now in a total distance of 85 ft. This was in copper-bearing formation to a greater or less extent for the entire distance. The extension today opened up a grade of rock that is highly gratifying and better than anything so far found in this direction. At a point 40 ft. from the shaft a drift was run from this cross-cut and now is in 30 ft. This entire distance was favorable and the breast now is in fair looking material. Altogether the exploration of the vein at this level is meeting expectations in that it is furnishing accurate data relative to the characteristics of the vein. That is the prime importance. The percentage of discard in underground work was 19, a total of 173,679 tons from 898,346 tons of 'rock' hoisted. In No. 2 shaft 50% of the ground is available for stoping. Three-quarters of the distance developed in No. 4 is suitable for mining. In No. 5 shaft the bottom is in trap 37 ft. below the 19th level and about three-quarters of the opened ground can be mined. In No. 6 shaft 45% is ground that may be taken out. Greatest interest centres in No. 7 which is not now working. The seventh level, south, was extended to the point 1741 ft. from the shaft or beyond a point midway between No. 7 and the proposed location of No. 8. Most of the drift was in good quality material but the last 80 ft. was poor.

MONTANA

SILVER ORE FROM NEIHART DISTRICT.

NEIHART.—The Cascade Silver Mines Co., operating the Moulten mine, reports two recent discoveries on its property. The first, on the 700-ft. level, cut a 10-ft. shoot assaying 150 oz. silver that is improving in depth. On the 1300-ft. level a new orebody has been exposed for a width of 10 ft., the ore assaying 60 oz. Neither the hanging nor foot-wall has been reached yet. It is planned to extend a drift for 1000 ft., not only to show the extent of the ore but to give the mine an opening 300 ft. lower than the hoist. This, it is estimated, will save \$5000 per month in haulage of ore and of mine supplies. One hundred men are employed at the mine. The February production amounted to \$65,000.

The Neihart Mining Co. shipped 6 cars of ore to the Washoe smelter during the month of March, averaging 35 oz. silver and 80c. gold per ton. Twenty-eight men are employed.

JEFFERSON COUNTY.—The Mount Thompson Mining &

Milling Co. has been organized to finance the development of the Rhinehart mine, in the Cataract district. The mine is developed by tunnels which will be extended. New shaft work will be undertaken.

HAMILTON.—Philadelphia capital is behind the development of 14 claims located on Treasure hill. During the old boom days these claims were worked to a depth of 250 ft. and considerable silver and lead was developed though none was shipped.

HELENA.—The King Solomon mine in the Lump Gulch district has made its first shipment. The property is being operated by P. A. Danaker and associates. On the 750-ft. level of the Liverpool mine a new orebody has been opened for a distance of 100 ft. with an 18-in. face of ore assaying 35 oz. silver per ton. It is planned to commence stoping this ore soon.

SAN COULEE.—The Anaconda company has signified its intention of developing its coal mines, where 50 to 75 men will be employed until capacity production is reached. Houses are being built for the workmen and other necessary buildings are being constructed. The Great Northern railroad will be asked to build a spur to the mine.

LIBBY.—The Treasure Mountain Mining Co. capitalized for \$200,000 has been organized to develop three promising claims adjacent to the Luckens-Hazel mine about nine miles south of Libby. Preliminary work has uncovered good veins of lead-silver ore.

NEVADA

LESSEES ON FLORENCE ARE ACTIVE.

GOLDFIELD.—Seventeen mine-cars of ore have been broken from a new find of ore in the Cracker Jack lease on the Florence. Fifteen cars assay \$285 and two assay \$500 per ton. The ore is being taken from 30 ft. above the 358-ft. level, north of the Little Florence shaft, where a 2-ft. seam parallel to the main vein has been opened. It is estimated that from 15 to 17 tons of ore is ready for shipment. The seam is in the hanging wall of the vein, east of the Florence Divide stope, which is in the foot-wall. A drift has been driven 60 ft. north in the ore-shoot opened by the Silver Pick in leased territory and a raise has been driven 30 ft. from the intersection of the cross-cut through the vein with the drift. The value of the ore in the raise is from \$15 to \$40 and the drift, partly in the hanging wall of the vein, assays from \$5 to \$11. A cross-cut to explore 150 ft. under where the present work is being done is to be started.

QUARTZ MOUNTAIN.—Quartz mountain, 12 miles east of Goldfield, is the scene of a gold find that has been visited by many Goldfield and Tonopah engineers, who say the district has great possibilities. Only surface prospecting has been done, but the engineers say the width of the vein and assays secured are unusually promising.

WEST DIVIDE.—The West Divide is drifting north from a tunnel cutting the vein at a depth of 150 ft. and indications are that considerably more work will have to be done before the ore-shoot opened in the shaft is reached.

GIBRALTAR.—Recent work in the Gibraltar has proved the average value of the big quartz vein to be much lower than surface assays indicated, according to reliable reports, and it is said that much greater depth than is reached in the present work must be gained before good results can be expected.

TULE CANYON.—It is expected that in two or three weeks the holders of the option on the Ingalls will start work on a good scale. It has been decided that the mill cannot treat the desired tonnage and a number of other plants are under consideration for purchase. The first mining to be undertaken will be the sinking of the shaft an additional 100 feet.

NEW MEXICO

TWO NEW MILLS.

GRANT COUNTY.—The New Mexico Mining Co.'s concentrator, two miles south of Pinos Altos, is completed and has started on lead-zinc ore from its own and other mines in the district. The mill has a daily capacity of



DIAMOND-DRILLING OPERATIONS IN THE MOGOLLON MINE, NEW MEXICO

100 tons and is equipped for concentration with tables only. Experiments with flotation will probably result in the addition of flotation-machines. Development in this district had been greatly hindered by the complex nature of the ore found, and the operation of this mill on custom ore should greatly stimulate production. There is no other mill operating in this district.

HIDALGO COUNTY.—The Co-operative Mining Co., of Lordsburg, of which H. C. Walter is superintendent, has completed and lately put into operation a 50-ton mill equipped with ball-mills and straight flotation. The company, organized in 1919, has been steadily developing its ground and has several thousand tons of high-grade silver ore on the dump and a large tonnage blocked for mining. Active in the district also are the Ruby Silver Mining Co., owning adjoining ground, and J. C. Woodward, of Silver City, who is leasing on the Minneapolis mine.

OREGON

THE SILVER KING MINE.

MARION COUNTY.—The Silver King property consists of twelve lode claims, situated on the west slope of the Cascade mountains, and is reached by 20 miles of wagon-road leading up the Little North Santiam river from Lyons. Gold, silver, lead, and zinc are found in a system of three well-defined fissure veins. The widths are, respectively, 18, 20, and 130 ft., the last being known as the Queen of the West vein, on which considerable development work has been done. These drifts show a fair grade of ore throughout their entire length, the average contents being as follows: gold, 0.04 oz.; silver, 10 oz.; lead, 5%; and zinc, 3½%. The silver is generally associated with galena. However, silver in the form of argentite has been found. The zinc is found as sphalerite or its alteration products. The Silver King vein, which has a width of 8 ft., has a shaft 80 ft. deep. No development work has been done on the Queen of the Mountain vein, but its surface outcrop shows 20 ft. of profitable milling ore.

The company is now preparing to drive a cross-cut tunnel 1000 ft. long which will cut all three veins at a depth of 650 ft. At the present time a power-plant consisting of a 6-ft. Pelton water-wheel and a 12 by 14-in. Ingersoll-Rand air-compressor is being installed. Henline creek, which crosses the property, is to furnish water-power to operate the plant. The portal of the tunnel is at the foot of Silver King falls. At this point the creek has a sheer fall of 150 ft. and its volume during the driest season is never less than 60 cu. ft. per minute. If the veins cut by this tunnel are of the same character as those found in the upper workings, a flotation-plant will be built to make a concentrate which will be transported by auto-truck to the railroad. The Silver King mine is not a new discovery; it is stated that the early settlers and trappers made bullets from the rich silver-lead ore taken from the veins crossing Henline creek. Until recently, however, the district could not be reached except by pack-horses. With the building of the wagon-road along the North Santiam river development work was started. The company is organized under the laws of Oregon, and its officers are J. J. Langmack, E. E. Williams, and William S. Risley.

UTAH

SHORTAGE OF MINERS IN THE STATE IS ACUTE.

SALT LAKE CITY.—Shortage of miners is becoming so acute in Utah that many mines which operate entirely on company account are almost face to face with the alternative of going over to the leasing system or curtailing operations to one shift per day. The shortage is especially acute in the Park City district, where many more miners could be used; it being said that one company alone could use at least 90 to 100 more men. There are many districts in the State from which very little is being heard, but where mining activity is on the increase. Many good miners have entered districts which have been quiet for years and are said to be leasing old mines which can be

turned into paying ventures under present metal prices. Then, the leasing system adopted in a number of the larger mines of the State has permitted miners to make more than wages, so that a larger number are going into the leasing 'game'. Need for some real action on the part of mining companies to teach unskilled laborers how to mine was never more apparent. There are plenty of intelligent Americans who, it is believed, would welcome the opportunity of earning their living while learning how to become miners, at which employment they could double the wage they receive as laborers. For some time the Silver King Coalition Co. at Park City has been doing more or less work along this line. Young men of more than average intelligence are given employment as muckers and then gradually taught to become miners. However, it is said that the men hardly learn the business before they leave the company and take a lease in one of the other properties.

The mining, milling, and smelting operations of the Anaconda Copper Mining Co. are presented in great detail in an 8000-ft. moving-picture film, which was shown at the Strand theatre in Salt Lake City on March 29. The pictures were lent without charge by the Anaconda company to the Utah Chapter of the American Mining Congress and the State Industrial Commission to assist in the mine-safety campaign in this State. The underground scenes, which include drilling, timbering, tramming, and a picture of an actual blast, were taken by means of special arc lamps. The smelting and refining scenes are especially complete, showing interiors as well as exteriors of furnaces, shops, and laboratories. Causes and means for prevention of accidents are presented at intervals in the reels.

BINGHAM.—During 1919, the Utah Consolidated Mining Co. produced 126,893 tons of copper ore and 45,337 tons of lead ore, which yielded 5,710,346 lb. of copper, 13,072,177 lb. of lead, 373,180 oz. of silver, and 10,548 oz. of gold. The total amount of exploration and development work done was 17,407 ft. At the end of 1918, the deepest workings in the mine were on the 1600-ft. level. The results of exploration work on that level indicated that in depth the Highland Boy lode, after passing through a leaner zone, which commenced at the 1300-ft. level, was again showing enrichment. Sinking was therefore resumed, and the shaft is now between the 2200 and 2400-ft. levels. The 1800 and 2000-ft. levels are being opened up and the results so far have justified expectations; particularly on the latter, where a new orebody has been cut in the Highland Boy limestone. The 2400-ft. level will be opened up during 1920. During the past year, laboratory experiments for the treatment of the copper ores by flotation, confirmed by an actual mill-run of 2500 tons, showed conclusively that a reduction in production costs can be made by milling the copper ores, which will make available a large tonnage of ore in the mine heretofore classified as too low grade to be profitable. Plans are being completed for a 1000-ton mill, which will be constructed during the coming year.

EUREKA.—Ore shipments from this district for the week ending March 27 totaled 162 cars, an increase of 13

over the previous week. The Chief Consolidated heads the list with 36 cars; Dragon Consolidated, 28; Tintie Standard, 23; Iron Blossom, 13; Grand Central, 9; Eagle & Blue Bell, 9; Centennial-Eureka, 8; Colorado, 8; Mammoth, 6; Gemini, 5; Bullion-Beck, 4; Empire Mines, 3; Victoria, 3; Sunbeam, 2; Swansea, 2; Ridge & Valley, 1; Alaska, 1; and Eureka Hill, 1.

The new No. 2 shaft at the Chief Consolidated mine is being sunk and concreted at the rate of 65 ft. per month. This work is under the direction of Walter Fitch, Jr., and the character of the ground is such that sinking and concreting has been exceptionally difficult. The shaft is one of the largest in the State and is the first to be lined with concrete from top to bottom. The shaft is now about 1200 ft. deep, and sinking will continue to the perma-

BRITISH COLUMBIA

CALUMET & ARIZONA MAKES PURCHASE.

VICTORIA.—The Cornell mining claim, on Texada island, has been purchased by the Calumet & Arizona Mining Co. This property was located by W. H. Treat, of Seattle, 20 years ago, and was worked for a time and then abandoned. The Calumet company took an option on the claim two years ago, and, examination and exploration work having proved satisfactory, the purchase has been made. H. A. Morse, who represents the company, is on the ground and will start development operations.

STEWART.—The winze and raise at the Forty-Nine group, the faces of which are in high-grade ore, have been



A PROSPECT IN WEST SHINING TREE DISTRICT, ONTARIO

nent water-level, which will be at about 1800 ft. below the surface.

C. C. Griggs has been for the past two weeks compiling data and collecting information pertaining to a new concentrating plant for the ores of the May Day and Uncle Sam mines. It is understood that there is a large tonnage of milling ore in both properties, and undoubtedly the old May Day mill, which was abandoned some years ago, will be rehabilitated along up-to-date lines. It is likely that the work of remodeling the mill will be undertaken soon.

Three or four different contractors have taken a turn at the sinking of the Central Standard shaft, only to throw up the job after a few weeks or a few months. Sinking is difficult on account of the water; however the flow appears to be decreasing to some extent as the shaft progresses.

At a depth of about 160 ft. some quartz, carrying silver, has been cut in the shaft of the East Tintie Coalition property. This property was recently equipped with machinery and the present plans call for a continuation of the shaft-work until a depth of 400 or 500 ft. is reached.

stopped and the men are being used to drift on the Forty-Nine vein and to drive a cross-cut toward a vein that runs parallel to it. The Salmon River Mines, Ltd., has purchased the Jitney group, which adjoins the Forty-Nine. Development work on these claims will be started as soon as the snow is off the ground. Another consignment of 300 tons of ore, valued at about \$275 per ton, has been sent to the Tacoma smelter from the Premier mine. Work on the New Alaska, on the United States side of the boundary, is progressing favorably. The tunnel has penetrated 40 ft. of good ore. Work at the property of the Indian Mines, Ltd., is to be resumed at once.

ALICE ARM.—The Silver Horde group of four claims, through which the Wolf orebody is supposed to pass, has been sold to M. P. Olsen, who will start development as soon as the weather permits. The Department of Justice, at Ottawa, has notified the Taylor Mining Co. that it must show cause why its title to the Dolly Varden mine should not be annulled. The Dolly Varden Mines Co. had until April 11 in which to appeal against the decision of the Provincial Legislature, by which the Dolly Varden mine and railway was awarded to the Taylor Mining Co., sub-

ject to the performance of certain conditions. A considerable amount of staking is being done, notwithstanding the weather conditions, and it is said that a number of claims have been staked more than once. Some confusion is likely to ensue.

HAZELTON.—A two-foot vein of milling ore has been cut by the tunnel that is being driven at the Silver Standard mine. While the presence of this vein was known from surface open-cutting, it has not hitherto been worked. Several rich stringers have been cut by the tunnel, and one of them, that is six inches wide of almost pure argentiferous galena, is being drifted on. The mill, which has been overhauled, has been re-started.

NELSON.—The Motherlode mill, owned by the Nugget Mines company, is being thoroughly overhauled. Drifts have been extended on the vein that was recently cut by the cross-cut from the Motherlode workings, and the size of the vein and character of the ore remains unchanged. The Mining Corporation of Canada has taken up its option on the Yankee Girl mine, at Ymir, and will start development operations at once. The Consolidated M. & S. Co. has received a large order for fluorite from chemical works in the State of Indiana. The machinery at the Rock Candy mine, on Lynch creek, is to be put in shape, and production will be started at once. It is expected that the mine will turn out 18 cars of fluorite per week.

DUNCAN.—A two-bucket aerial tramway is being erected at the 'Hill 60' manganese mine, at Cowichan lake. Last summer a road was made to the mine at the joint expense of the Provincial government and the mine-owners, but, owing to the steepness of the grade, it was washed out by the fall rains. The tramway will convey the ore from the mine directly to the Esquimalt and Nanaimo railway. A 25-ft. face of ore averaging 25% manganese has been opened at the mine by open-cut.

ONTARIO

COBALT PROPERTY OPTIONED.

PORCUPINE.—The Clifton-Porcupine recently shipped two tons of ore to the Temiskaming ore-testing laboratories at Cobalt, where it was found to average \$66.45 per ton. Veins cut on the 200-ft. level have proved to be well mineralized. A dividend of 2½% has been declared by the Dome Mines payable April 30, a similar disbursement having been made on January 15. Prior to closing down on account of the War the company paid 5% quarterly dividends, but under present conditions until a large surplus is created it is considered unlikely that dividend payments will be resumed on the former scale.

KIRKLAND LAKE.—The Bidgood has let a contract for the sinking of a 300-ft. shaft and 2000 ft. of lateral work at that depth. The Moffatt-Hall, a new company capitalized at \$3,000,000, has taken over 12 claims comprising about 500 acres in the Lebel Township section of the Kirkland Lake area. Work at the Fidelity has been for some time at a standstill owing to the breaking down of the compressor early in March. Exploration will be resumed as soon as repairs are made.

BOURKES' SIDING.—Plans for a new mill at the

Bourkes' gold mines are being prepared. It is proposed to erect a plant with a capacity of about 50 tons per day. The property is situated some 12 miles north-west of the proved gold-bearing zone of Kirkland Lake. Geological conditions are favorable and the deposition of gold is quite heavy, though occurring in narrow streaks. A system of selective mining will be followed. The Better Ole Syndicate, organized by returned soldiers, of which Bruce Bairnsfather, the cartoonist, is honorary vice-president, has taken over the P. J. Ashby claims, comprising 320 acres, 2½ miles from Bourkes' Siding, on which five veins have been opened up and considerable trenching done. The Lake View is getting in a 5-drill compressor and other mining machinery.

WEST SHINING TREE.—The Atlas will build an amalgamating-mill for the treatment of high-grade ore. This plan was decided upon following a test of 602 lb. of ore at McGill University, which showed gold to the value of \$64.92 per ton and recovery by amalgamation at the rate of \$47.38 per ton. Owing to the cost of a cyanide-plant the company decided on building a 60-ton amalgamation-mill and saving the tailing for future treatment. The directors of the Wasapika have laid out plans for a considerable expansion of the scale of operations which will be submitted to the consideration of the shareholders.

COBALT.—According to dispatches from The Pas, the Flin-Flon property has been optioned by the Mining Corporation of Canada and W. B. Thompson, of New York. It has been agreed to spend at least \$200,000 in exploring the large sulphide deposit; and to this end mining machinery necessary to sink two shafts is being transported to the property. It is stated that William Koerner, of New York, will manage the work, and that a force of about 60 miners will be engaged as quickly as possible. Following six months or so of exploration, it is believed the importance of the deposit will be ascertained and the holders of the option can reach a decision on the question of whether or not the construction of a railway from The Pas to the property is warranted.

The promoters of the proposed Northern Light Railway announce that, provided they receive a charter to build a light narrow-gauge railway from Elk Lake to Gowganda, they are in a position to commence the work immediately, and that within a few weeks they will complete the laying of the 27 miles of steel.

On account of quotations for silver having receded about ten points during March, the Cobalt producers withheld bullion shipments. At the end of the month, when quotations advanced, shipments were resumed.

GOWGANDA.—On the Kells property in Cokhill township, ore containing around 5000 oz. silver per ton has been found at a depth of 80 ft. The vein is but two inches in width, in this respect resembling many of the high-grade veins in Cobalt, but it is running parallel to three other veins which contain medium-grade ore at the surface. The development on the Kells is attracting interest on account of the property being some 50 miles north-west from Cobalt and about 12 miles south-east from Gowganda.



CALIFORNIA

Calaveras County.—The old Sheepranch mine, which has been under development for two years, is in shape to start production, according to H. R. Plate, who has directed the work. The present operators have sunk to the 1700-ft. level and have drifted from the 1550 and 1700-ft. points. There is a continuous stoping length of 1300 ft. The vein is five feet wide between walls, though the gold-bearing quartz will average only about $1\frac{1}{2}$ ft. The average value of the clean quartz is over \$20 per ton, but the estimated grade of the mill-feed will be about \$12. The company expects to remodel the old 20-stamp mill and add a cyanide plant with a capacity of 100 tons per day. It is expected to have everything in readiness to commence production by July 1.

The Carson Hill company has developed its lowest level (1100-ft.) to such an extent that predictions have now

and numerous drifts. The management states that two good veins have been uncovered.

Redding.—F. A. Zimmerman has bought the Easterly mine one mile west of Shasta from George Easterly. A little high-grade ore has been shipped from the Easterly, which was located only four years ago.—The two-compartment shaft at the Little Nellie mine, between Keswick and Iron Mountain, has been sunk 300 ft. in three months.

Shasta County.—Development of the large deposit of copper ore recently uncovered in its Friday-Lowden property by the Mammoth Copper Co. is showing good results. It is reported that 120,000 tons of ore has already been placed in sight, with the orebody gaining strength as work advances. According to officials, the Afterthought mine and plant will remain idle until the copper situation becomes sufficiently improved. The present low price of the metal precludes production, as costs are much heavier than in former years.



UNDERWRITERS AND ADMIRALTY MILLS IN THE JOPLIN DISTRICT

given place to actual assays and over a 10-ft. width the vein averages \$56 per ton in gold. The company is shipping from 25 to 35 tons of ore daily from this point, with some of the ore running as high as \$65 per ton. Although the exact dip of the vein between the 865 and 1100-ft. levels has not yet been determined it is estimated that there is 250 ft. of vertical stoping ground. This puts in sight a large tonnage of ore which preliminary operations have shown will average fully as rich as on the levels above. The company has made several important changes in its plant and equipment. The mill is being increased through the construction of 10 additional stamps. A cyanide-plant is under construction which will effect further saving of gold and by mid-summer capacity will have been increased to 12,000 tons per month, or approximately 150,000 tons per year. Costs are now a little over \$4.60 per ton and when operations are swinging near the capacity mark, costs should not exceed \$4.

Grass Valley.—The erection of a five-stamp mill has been decided on by the Grass Valley Boundary Co. The mine is a new enterprise, located at the western edge of Grass Valley, and considerable ore has been extracted in the course of development work. Workings comprise a 200-ft. shaft

It is declared that the process proved satisfactory and that operations will be resumed as soon as the copper market warrants.

With two shifts employed the Colma Copper Co. is driving ahead the main tunnel in exploration of the Uncle Sam group. The lateral had a length of 1500 ft. when work began and will be driven about a mile. It will explore at greater depth promising territory already prospected by drifts from the Mammoth mine. New equipment has been ordered and driving will soon be speeded up with three shifts.

MISSOURI

Joplin.—The Kitty mill, west of Cardin, that has been down about five weeks because of damage done by fire, has resumed operations and soon should be producing as well as ever. It was necessary to re-build the mill-derrick and hopper and the east end of the mill, as the original structure was destroyed by fire and dynamite used to help in extinguishing the flames. The origin of the fire has never been learned. It started in the derrick away from the electric wiring and the only theory advanced is that there was spontaneous combustion of coal-dust. In order to keep the fire

from reaching the main portions of the mill, four boxes of dynamite were exploded ahead of the fire, blowing up much of the material on which the fire was feeding. This held back the flames until a fire-company from Miami arrived.

The new mill of the Hunt Mining company is being erected rapidly on the site of the mill formerly known as the Pittsburgh-Miami, which was destroyed by fire two months ago. The new mill is being constructed of galvanized iron and is somewhat larger than the old one. The building is almost finished and some of the machinery has been placed. The Hunt Mining Co. came into possession of the property this year and within a short time the plant was operating steadily, proving to be a good producer.

MONTANA

Butte.—The Davis-Daly company during March produced the largest tonnage in the company's history and a further improvement is looked for in April. New ore-bins and sorting devices are in operation. The ore is conveyed from the skip by means of a conveyor-belt with two men on each side picking waste. For each ton of waste sorted the company saves \$9, and these four men can pick out 20 tons daily, effecting a saving of approximately \$180 per day. The ore-body recently reported on the 2700-ft. level is about eight feet wide and has an estimated copper content across this width of 6%. This vein cannot be regarded as one of the objectives of the cross-cut on this level; the several fissures opened on the 2500-ft. level, for which the working is headed, will be cut within five or six weeks.

NEVADA

Eureka.—At the Eureka-Croesus ore is being extracted from the 400-ft. level and stored in the bins at the mine while the roads are blocked. It is planned to start hauling as soon as the roads become open to traffic. The face of the Eureka-King tunnel is still in the black shale, but as it has been driven now about 400 ft. in this formation, it is expected that the contact will soon be reached, when the direction of working will be turned toward the Eureka tunnel, in order to get under the high-grade orebodies that were mined in the early days. This tunnel is 550 ft. below the Eureka tunnel.

Lovelock.—A raise from the face of the lower tunnel in the Jose-Davis company's lease on the Sheepherder, 10 miles north-east of here, has broken into the shoot of high-grade ore that is being mined above the upper tunnel. The ore contains free gold and is as rich as in the other workings. Ore now going through the Gibson mill averages between \$80 and \$100 per ton.

National.—Lessees on the Buckskin-National property are said to have opened ore assaying from \$250 to \$600 in gold and silver at a depth of 380 ft. The find was made in a winze sunk 50 ft. from the 900-ft. main tunnel. A drift has been driven 28 ft. in the rich ore, exceptionally high-grade material being found in seams on the walls and it is estimated that the 10-ft. width will break \$100 per ton.

Pioche.—Operations at the Black Metal company are being curtailed on account of the shortage of labor. The company is producing about 75 tons per day of lime fluxing-ore, carrying from 12 to 15 oz. silver per ton, a product in demand at the Salt Lake Valley smelters.

The main shaft of the Prince Consolidated has now reached a vertical depth of 585 ft. and better progress will be made from now on. Water is being handled satisfactorily and the flow is rapidly becoming stabilized as the fissure pockets are drained; 1400 tons is being shipped each week.

At the Virginia Louise eight underground headings are being driven. On the first level the work is confined to the intermediate drift and raises. On the third level a long exploratory drift is being run under the area exposed by the second-level drift, which will prove the ore-bearing territory exposed on the level above. On the fourth level the most noteworthy development is the improvement in the

character of the ore in the 410-ft. stope, which ore showed a marked decrease in the insoluble content with a corresponding increase in iron and manganese. Samples from the face of the drift on the fifth level assay 5% lead with a corresponding silver content.

NEW MEXICO

Socorro County.—As a result of the re-organization plans that have been approved by Judge Colin Neblett, of the United States District Court, the Socorro Mining & Milling Co. will soon discharge the receiver and resume operations. The company, whose mine and mill are at Mogollon, was a large producer of gold and silver. A year ago the company went into the hands of a receiver, when D. B. Scott, superintendent, was put in charge by the court. The plant remained in operation about 60 days on clean-up work and then was closed down. With adequate capital for development the property is expected to be profitable. This has been provided by A. W. Wallace and associates from Detroit.

Sierra County.—Chloride, once the scene of active silver mining operations, is the centre of considerable excitement resulting from the discovery of tin ore. Prospectors are busy on Turkey, Taylor, and Squaw creeks, and rich discoveries are also reported at the Bob Akes ranch on the east fork. On the Turkey creek claims a 65-ft. cross-cut tunnel has been completed and the entire length is said to be in ore. The New York owners of the claim have asked for bids on 1500 ft. of tunnel with a cross-cut every 200 ft., which will establish the extent of the deposit. At present there are no roads into the district. The nearest road is from Magdalen to the old 'V-Cross-T' ranch, now owned by the Evans brothers, and it can be traveled with heavy motor-trucks. A road can be built from this place to connect the Taylor creek mines at small expense.

OREGON

Josephine County.—The Alameda Mines, whose property is in the Galice mining district, has a crew of men at work cleaning up tunnels, cross-cut, and raises and re-timbering. The work is being done under the supervision of Harry Sordy, who took charge of the property last October. He has opened several good veins of gold-silver ore.

WASHINGTON

Republic.—J. W. C. Lanskill is operating the Quilp mine and shipping weekly 500 tons of ore to Tacoma and 100 tons to Northport. The Know Hill mine is shipping 100 tons per week to Tacoma.

Stevens County.—The Aichan Bee Silver-Lead Mining Co., in the Deer Trail district, is hauling machinery by truck from Spokane, according to H. W. Howard, manager. Some fine orebodies in the 22-ft. vein are being opened. On the foot-wall is 6½ ft. of lead ore, carrying 24% zinc, with just enough iron to make it a desirable fluxing ore. On the hanging wall is 2½ ft. of silver-lead ore that assays \$78 per ton. The entire 22 ft. returned \$43 per ton from a 200-ton mill-test.—E. L. Van Horn is taking out tungsten ore from a property he has secured on the Spokane Indian reservation, near the old Germania mine, according to reports. The ore is wolframite worth about \$7 per unit.

YUKON TERRITORY

White Horse.—Shaft-sinking has been stopped for the time being on Lookout mountain and the men are being employed in getting out ore and hauling it to Mayo landing. It is expected that several hundred tons will be delivered by the time navigation opens. All signs point to an early season, this year, and it is expected that shipping will start early in May.—Rich ore has been found at several places on Keno hill, particularly on the Yukon Gold Mining Co. and the McKay-Erickson properties. All the material for a dredge has been delivered at Hight creek and the machinery is being assembled. It will be ready for use early in the season.

Hoover Will Accept Nomination

The following telegram was sent by Mr. Hoover on March 30 to Warren Gregory, president of the Hoover Republican Club of California:

I had not wished to enter nor could I hitherto see any real public service by entering into partisan political discussion, more especially pending the clarification of the diverging views of the different groups in the parties on the great new issues. The recent developments over the Treaty, stagnation in adjustment of our great economic problems, and particularly the many urgent representations that I have received as to the situation in my own State convince me that it is my duty to confirm the action that my Republican friends there have already taken without consulting me.

I understand that there is a great wish among the Republicans of California to have opportunity to express themselves in favor of the League of Nations with proper reservations safeguarding American tradition and interests, as opposed to the extreme view advocated against any League at all. I differ just as strongly with this view as I differ with the extreme position taken by the President on participation in purely European affairs. This issue is whether, with reservations protecting our position, we should join the moral forces of the world to reduce the dangers again growing around us, or whether we will, by pretense of an insularity that we do not possess, sit by in the face of growing armies, navies, National antagonisms, reaction or, in reverse, the spread of Bolshevism, through much of the world. This would be the defeat of the hopes for which our sons were sacrificed in this war.

Entirely aside from this moral idealism of the League and the danger to our own ultimate peace, the solution of our domestic problems, such as the size of our armament, reduction in taxation, and the prevention of agricultural and industrial depression and consequent unemployment, is dependent upon stability abroad and upon our access to the world's markets which today are endangered by discrimination against us through our inability to exercise our veto under the Treaty. I believe it is the transcendent service which the Republican party can render to the Nation to settle a League efficiently designed to give us these National protections.

No one should be able to dictate the policies of great parties, yet every man and woman has a right to decide what issues and measures he will support. If the Republican party—with the independent element of which I am naturally affiliated—adopts a forward looking, liberal, constructive platform on the Treaty and on our economic issues and if the party proposes measures for sound business administration of the country, and is neither reactionary nor radical in its approach to our great domestic questions and is backed by men who undoubtedly assure the consummation of these policies and measures, I will give it my entire support. While I do not and will not myself seek the nomination, if it is felt that the issues necessitate it and it is demanded of me, I cannot refuse service.

HERBERT C. HOOVER.

The following telegram was sent also on March 30 by Mr. Hoover to Ralph P. Merritt, campaign manager for the Hoover Republican Club of California:

My views on the treaty situation are as follows: Regardless of what any of us may think should have been the provisions of either the League or the Treaty, we and the world should not be kept waiting longer for a settlement. The whole process of peace has been necessarily one of compromise, and so long as the final form gives us freedom of action and room for constructive development of peace I believe it should be accepted.

The reservations should satisfy the most timid as to entanglements, and despite the feeling of the President and his associates that the strength of the League is somewhat undermined, I believe that they should also accept. I do not believe that the Lodge reservations, as recently modified, destroy the possibility of the creation of a potent organization to mitigate the dangers in front of us, and the alternatives are a continuation of our state of war for another year, or the unthinkable thing for us to make a separate peace after we have gone so far as to agree on its main lines with comrades in arms.

Due to this unsettlement and other causes that the League would mitigate, the world is steadily drifting back to a worse state of international antagonism than existed before 1914. The naval strength of every great nation, except the enemy and Russia, has been increased during the War. Many great armies have been demobilized, yet the world is again engaged in preparedness and the actual number of men under arms today is much larger than before 1914. The world's total armament and its military expenditure is larger despite the burden of grinding debt. No moderating influences can be set up until we come to a conclusion and join the League that was created at our inspiration, and upon which the entire theme of settlement, our real hope of a better world, revolves.

The President seems to feel that the foundations of the League rest upon our participating—subject to approval of Congress on use of force—in an obligation to preserve the territorial integrity and political independence of its members against aggression. Without entering upon this method of preventing aggression, I believe a great foundation of peace does lie in the continuous functioning of a body of great international representatives sitting outside the pettiness of day-to-day international relations, engaged upon conciliation, the mitigation of antagonism; the very effective boycott of disturbers through arousal of public opinion against them, and through it the immediate undertaking of disarmament of the world, to a simple defensive footing.

This war surely demonstrates that nations become aggressive largely through the permanent military class that grows out of the maintenance of large armies and navies, with all the social, political, commercial, and propaganda pressures that naturally spring up around them. Military groups in these days always go into action on the claim of self-defense, and to none of them is aggression held in check against so-called military necessity. Their view of political independence is boundaries of purely military character, itself a basis of friction. A reduction of armament would directly lessen the influence of these groups, who are themselves the cultivators of war.

This question of disarmament is a vital issue to us. We are dependent upon our foreign trade for much of our prosperity, and the naval and military strength of the world is concentrated in fewer hands today than in 1914. If there be the League, sitting in the development of methods of peace in localization of possible conflict, I have no doubt that the great majority of the British, French, and Italian people will be themselves the first to approve of a reduction of naval and other armament; for they, too, are suffering under its burden. If we can secure no safety by disarmament we must tax ourselves a couple of billions a year and enter a race of preparedness and build up a military caste of our own. Is it not worth entering the League with the determination to at once test its value on the reduction of armament to a real defense basis within a measurable time, before we enter this race, with no goal but misery and danger?

There are other great practical issues which should be considered before we close our only door to the immediate solution of this situation. If the Treaty fails ratification now it apparently must be kept on the American stage for a year until the next administration, in which case we re-

main legally at war with Germany, or, alternatively, we must make a separate peace. If the first course is adopted, our citizens would have no right in Germany or Austria—our passports would not run there—we would have no proper equality in trade with a large portion of Europe.

We do not need to be involved in scores of treaty commissions dealing with purely European matters, yet the reparation commission is an accomplished fact, and is the most powerful economic body in the world. It is today conducting, without our veto, a control that effects our trade, not only in Europe, but many other interests highly important to us closer to home. Naturally, with us outside the Treaty, we must expect the commission to at least neglect our interests.

All of our war legislation would still continue as a ready weapon for administrative use. We must be forced to go on with our military budgets to meet the growing dangers that develop. We would be exerting no influence to mitigate the growth of the old system of antagonism and combinations.

Another alternative is that we abandon this Treaty. That is: We ask Germany to negotiate a separate peace with us. Having thus isolated ourselves from the Allies, and withdrawn any consequential army from Europe, can we suppose that Germany will accept the Versailles terms from us? Will we resume fighting again? We shall be in the position of a nation that has abandoned its allies after having made an agreement with them for the main lines of the Treaty as distinguished from the League provisions, which are not challenged even by reservations.

Will not the Germans thus effectually drive a cleavage between us and the Allies? As the reparation commission can effectually veto any settlement we make with Germany for civilian losses, alien property, and trade matters, shall we go to the Allies and ask their help? Some of the terms of the Versailles treaty may be proving impractical, but instead of sitting with our associates in friendly effort to develop such changes as may be demonstrated as necessary, are we, at Germany's and Austria's insistence as equals in the new negotiations, to admit changes in these provisions that will create antagonism of all the Allies?

In my view, the soul of the League as an influence to the prevention of war, may have died in world antagonism, long before we can come to our Presidential election. The League is not a document—it is an organization of the moral sense of the civilized states. Without their combined goodwill it can never succeed. In any event, the League is, of course, already in actual being among the other members. It cannot, however, become a real beneficent force, unless it contains the support of all the great powers; and this can only come about by our entrance. With us out, it is in great danger of developing into an organization for the advancement of certain national interests; and we may find it an economic, if not a political league against us, for we are the creditors of the world today. The adherence to it of other countries in the Western hemisphere, may direct their political perspective to Europe, instead of to the United States, and a cleavage may be driven in the bond for peace that we have striven to establish in this hemisphere.

Are any of these alternatives better to anyone than acceptance of the Treaty as passed by the majority of the Senate? Is it not the practical thing to ratify it, and then to build constructively toward peace and goodwill? If the League proves a success the world will readily grant it greater powers. All these are the issues of self-interest. There are greater issues than these. Two years ago when the entire world was aligned against Germany, our prayer was that we might be fighting the last great war—that something better should come to the world in return for the sacrifice. Today, the world is drifting back, and through our failure. Victory may turn to new antagonisms.

HERBERT C. HOOVER.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. W. Whitley is at San Diego, California.

H. V. Burgard, of Denver, was in San Francisco last week.

Luther B. Eames has returned to Denver after a short stay here.

T. A. Rickard attended the International Mining Convention at Seattle.

Edward E. Free, chemical engineer, of Baltimore, was here this week.

Francis Webb, of Denver, sails from New York for England on April 17.

Abbott A. Hanks was at Seattle this week, attending the Mining Convention.

S. J. Lewis is erecting a mill on his mine at Zacualpan, in the State of Mexico.

Charles Bocking, manager for the Butte & Superior Mining Co., is in New York.

Stanly A. Easton, manager of the Bunker Hill, is taking a short holiday at Del Monte, California.

D. D. Moffat has returned to his headquarters at Salt Lake City, after a trip to Duluth and Chicago.

C. W. Adams, manager of the East Helena plant of the A. S. & R. Co., has been in Utah recently.

H. A. Guess, of the A. S. & R. Co., has been in Utah recently, visiting the company's properties there.

Harry J. Wolf has resumed general practice as mining engineer with offices at 42 Broadway, New York.

Alexander S. Prosky, president of the Seminole Regent and Argentine-Divide companies, is here from Reno.

S. F. Taylor, of New York, president of the Como Consolidated Mining Co., was in San Francisco for a few days last week.

Marcus Lobb, of Toronto, representing the Canadian Royal Mining & Operation Co., is visiting mining and metallurgical plants in Utah.

W. D. Leonard, assistant manager of the Colorado Department of the A. S. & R. Co., was a visitor at the company's Utah plants recently.

C. G. Rice, of Boston, has been elected president of the U. S. Smelting, Refining & Mining Co., to fill the vacancy caused by the death of William G. Sharp last July.

S. M. Soupcoff, mining engineer with the Utah Department of the A. S. & R. Co., has returned to Salt Lake City after an inspection trip to the Nacozari district, Mexico.

Frederick R. Weekes, of New York, and J. J. Stubenford, of Long Beach, California, have been making an examination of the Naildriver mine at Park City, Utah, for Eastern interests.

A. C. Boyle, Jr., Professor of Mining and Metallurgy at the University of Wyoming, accompanied by a party of ten students, has been visiting mines and metallurgical plants in Utah.

Richard Roberts died at his own home in Wales on March 19. He was expecting to return to Wardner, Idaho, where he lived for 25 years. 'Uncle Dicky' was well known and highly regarded in the Coeur d'Alene. For 30 years he worked in the Bunker Hill mine and was always one of the best of that company's employees. In later years he was successful in a lease on the west branch of the Reed tunnel, where he was operating, through his associates, at the time of his death. He was an honest worker, a good citizen, and a loyal friend.

THE METAL MARKET



METAL PRICES

San Francisco, April 6

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11
Copper electrolytic, cents per pound.....	19
Lead, pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$135
Platinum, 10% iridium, per ounce.....	\$155
Quicksilver, per flask of 75 lb.....	\$100
Spelter, cents per pound.....	10.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

April 5—Copper is quiet and strong. Lead is dull and firmer. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

		New York	London	Average week ending			
Date		cents	pence				
Mch.	30	126.50	72.12	Feb.	23	130.00	82.55
"	31	126.50	72.62	Mch.	1	129.87	79.75
Apr.	1	126.50	72.12	"	8	130.37	81.16
"	2	Holiday		"	15	121.90	72.14
"	3	126.50	Holiday	"	22	123.42	70.35
"	4	Sunday		"	29	125.81	71.64
"	5	126.50	Holiday	Apr.	5	126.50	72.29
Monthly averages							
		1918	1919			1918	1919
Jan.		88.72	101.12	July		99.62	106.36
Feb.		85.79	101.12	Aug.		100.31	111.35
Mch.		88.11	101.12	Sept.		101.12	113.92
Apr.		86.35	101.12	Oct.		101.12	119.10
May		89.50	107.23	Nov.		101.12	127.57
June		89.50	110.50	Dec.		101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Data				Average week ending			
Feb.	30	1900		Feb.	23	1902	
"	31	1900		Mch.	1	1881	
Apr.	1	1900		"	8	1862	
"	2 Holiday			"	15	1837	
"	3	1925		"	22	1810	
"	4 Sunday			"	29	1866	
"	5	1925		Apr.	5	1910	
Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	
Apr.	23.50	15.23		Oct.	26.00	21.66	
May	23.50	15.91		Nov.	26.00	20.45	
June	23.50	17.53		Dec.	26.00	18.55	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date is quoted in cents per pound, New York delivery.									
				Average week ending					
Jan.	30	8.87	Feb.	23	8.92				
	31	8.87	Mch.	1	9.18				
Apr.	1	8.87		8	9.43				
	2 Holiday		"	15	9.50				
	3	9.00	"	22	9.10				
	4 Sunday		"	29	8.90				
	5	9.00	Apr.	5	8.92				
Monthly averages									
	1918	1919	1920		1918	1919	1920		
Jan.	6.85	5.60	8.65	July	8.03	5.53			
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78			
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02			
Apr.	6.99	5.05	.....	Oct.	8.05	6.40			
May	6.88	5.04	.....	Nov.	8.05	6.76			
June	7.59	5.32	.....	Dec.	6.90	7.12			

TIN

Prices in New York, in cents per pound:

Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	83.00	70.11	.....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	.....
Mch.	85.00	72.50	61.82	Sept.	80.40	55.79	.....
Apr.	88.53	72.50	.....	Oct.	78.82	54.82	.....
May	100.01	72.50	.....	Nov.	73.67	54.17	.....
June	91.00	71.83	.....	Dec.	71.52	54.94	.....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date				Average week ending			
Jan.	30		8.85	Feb.	23		8.25
Mch.	31		8.95	Mch.	1		9.20
Apr.	1		8.95	"	8		8.95
"	2	Holiday		"	15		9.06
"	3		8.95	"	22		8.91
"	4	Sunday		"	29		8.87
"	5		8.95	Apr.	5		8.83
Monthly averages							
	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.58	July	8.72	7.78	
Feb.	7.97	8.71	9.15	Aug.	8.78	7.81	
Mch.	7.87	8.53	8.93	Sept.	9.58	7.57	
Apr.	7.04	8.49		Oct.	9.11	7.83	
May	7.92	6.43		Nov.	8.75	8.12	
June	7.92	6.91		Dec.	8.49	8.87	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918			1919			1920		
Mch.	9		80.00	Mch.	30		90.00		
"	16		85.00	"	23		95.00		
				Apr.	6		100.00		
Monthly averages									
		1918	1919			1918	1919	1920	
Jan.	128.06	103.75	89.20	July	120.00	100.00			
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00			
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60			
Apr.	115.00			Oct.	120.00	86.00			
May	110.00	84.80		Nov.	120.00	78.00			
June	112.00	94.40		Dec.	115.00	95.00			

REVISION OF FEDERAL TAXATION

Secretary Houston, of the Treasury Department, has recommended measures for the simplification of income and excess profit taxes. He is quoted as saying:

Complexities in tax laws violate the most fundamental canon of taxation, that the liability shall be certain and definite. It is not merely a source of irritation, labor, and expense to the taxpayer, but when conjoined, as it is in the present law, with the heavy rates of taxation which war exigency has forced upon us, it becomes a menace, threatening enterprise with heavy but indefinable future obligations, generating a cloud of old claims and potential back-taxes which fill the taxpayer with dread, creating, to be sure, an attractive source of additional revenue, but clogging the administrative machinery and threatening indeed its breakdown.

Final determination and settlement of tax claims and assessments—I recommend therefore as the most urgent and important of the measures of simplification which could advantageously be put into effect at once, an amendment authorizing the Commissioner of Internal Revenue, with the consent of the taxpayer and the approval of the Secretary of the Treasury (or under such other public safeguards as the Congress may prefer), to make a final determination and settlement of any tax claim or assessment, which shall not thereafter be re-opened by the Government or modified or set aside by any officer, employee, or court of the United States, except upon a showing of fraud, malfeasance, or misrepresentation of fact materially affecting the determination thus made.

This recommendation is of major importance. At present the taxpayer never knows when he is through. Every time an old ruling is changed by court decision, opinion of the Attorney-General, or re-consideration by the department, the department feels bound to apply the new ruling to past transactions. The necessity of constantly correcting old returns and settlements is as distressing to the department as it is obnoxious to the taxpayer.

Interpretive regulations or Treasury decisions not to be retroactive—as a desirable concomitant of the preceding suggestion and for reasons stated in explaining that suggestion, I recommend the adoption of an amendment providing in substance that in case of a regulation or Treasury decision made by the Commissioner or the Secretary or by the Commissioner with the approval of the Secretary is reversed by the subsequent issue of a similar regulation or decision, and such reversal is not immediately caused by or based upon an opinion of the Attorney-General or a decision of a court of competent jurisdiction, such new regulation or decision may be made effective from the date of approval.

Five-year limitation on time for bringing suit for collection of taxes—Section 250 of the Revenue Act of 1918 now provides, in sub-division (d) that no suit or proceedings for the collection of any tax shall be begun after the expiration of five years after the date when the return was due or was made, except in the case of false or fraudulent returns with intent to evade the tax. This subdivision has been held to apply only to taxes due under the revenue act of 1918. I recommend that this time limit be extended to all income and profits taxes due either under present or prior acts of Congress.

MONEY AND EXCHANGE

Foreign quotations on April 6 are as follows:

Sterling, dollars:	Cable	4.03 1/4
	Demand	4.02 1/2
Francs, cents:	Cable	6.90
	Demand	6.89
Lire, cents:	Demand	4.87
Marks, cents		1.60

Eastern Metal Market

New York, March 31.

The markets are nearly all more active and stronger with a better demand in most of them.

Buying of copper is heavy and prices are higher and advancing.

There is much more activity in tin and buying by consumers has been and is a feature.

The lead market is quiet and easier with prices fairly steady.

Demand for zinc is very light but values are fairly steady. Antimony is quiet and unchanged.

IRON AND STEEL

Predictions of easier conditions in steel products continue, due in part to the volume of business booked at the Steel Corporation prices and in part to prospects for larger output and freer shipments, says 'The Iron Age'. Yet current buying and selling show no reduction of the higher prices recently paid in ordinary transactions with independent mills.

The higher coke prices predicted in view of the release of Government control April 1 are already a fact. Blast-furnace coke has sold at \$10, one such contract as of April 1 calling for 15,000 tons in the second quarter, and as high as \$12 has been paid for prompt coke. Higher pig-iron, because of higher coke and higher freight rates, is the prediction of sellers.

Signs are that the steel producers will take some of the notes of the railroads in payment for car-building material, just as the car-builders themselves have at other times accepted negotiable car-trust certificates.

COPPER

Interest in copper is growing. Buying particularly by domestic consumers has been and is heavy and prices are higher. The predicted buying movement is apparently on and the tone of the market is strong. Electrolytic copper is quoted and being sold by the large producers at 19c., New York, for early delivery with Lake copper at 19.25c., New York. For June a slight premium is obtained in some cases. Export business is much better, also at premium prices over domestic sales. Twenty-cent copper is predicted for the near future. There is a disposition to decline third-quarter business, so confident are sellers of a rising market. The recent statement of the head of the Export Association has had a stimulating effect. The plans for the formation of a revolving fund to finance foreign buying are nearer fruition.

LEAD

The market is quiet and steady. Lead which has been held up in transit is moving more freely into consumption, rendering the entire situation easier. The leading interest still maintains its quotation at 9c., St. Louis, or 9.25c., New York, for early delivery and there has been no material change in the outside market. We quote for early delivery in wholesale lots at 8.75c., St. Louis, or 9c., New York, with demand fair and consumption still heavy. The present easier conditions are believed by one large seller to be only temporary as production has not improved enough to maintain supplies equal to ultimate demand.

TIN

The market is in more normal condition in that it is now largely in the hands of importers and less under the control of dealers and speculators. Demand from consumers is also heavier and gaining in volume. From March 23 to 27 buying was large, averaging 250 tons or more each day, mostly for nearby position. A good business in futures was also done.

On Monday business was done at from 62.50 to 63c., New

York; on Tuesday at 63.75c. More could have been sold but supplies are evidently concentrated in strong hands who are unwilling to part with all their metal at once. Yesterday spot Straits was sold at an average of 63.75c., New York, against an average of 62.62½c. on Monday, the higher values were due to an advance in the London market of £13 to £14 per ton, spot Straits being quoted there at £359 55s. per ton. Arrivals to date this month have been 4175 tons, of which only 180 tons came in at Pacific ports. The quantity afloat is 2215 tons. Besides 50 tons exported this month to Germany there has been 15 tons sent to Japan.

ZINC

The week has been a very quiet one in this market. Not much business is reported as transacted. Prices have been less erratic than a week ago although they have followed to a large extent the fluctuations in the London market and the changes in the pound sterling. Export demand is now light and domestic buying is only fair. On the dips there have been fair purchases of prime Western. In view of the heavier demand for copper, buying of brass-special metal is expected to develop. For early delivery and shipment into the third quarter, prime Western is obtainable and has been sold today at 8.50c., St. Louis, or 8.85c., New York.

ANTIMONY

The market is quiet and unchanged with wholesale lots for early delivery held at 11.50c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99% pure, is obtainable at 33c., New York, from the leading interest and at 31c., New York from the outside market.

ORES

Tungsten: The tariff matter is the all-absorbing topic now and business in the meantime is in check. There is less opposition to the measure among certain interests than there was, but opinion is divided as to whether any tariff will be passed. Quotations are nominal at \$6.50 to \$15 per unit, depending on the grade of the ore and the delivery.

Ferro-tungsten and tungsten powder are obtainable at anywhere from 90c. to \$1.15 per lb. of contained tungsten.

Molybdenum: The market is quiet and prices are nominal at 75c. per lb. of MoS₃ in regular concentrates.

Manganese: Imports of high-grade ore in February were only 4106 gross tons, or the lowest for any month since early in 1915. These data came with a startling effect on the present tight situation in the entire manganese market. Foreign ore for early delivery has sold in the last few days at 80c. per unit, seaboard, in lots up to 600 tons, and other quantities of Indian ore are under negotiation. There is also available some high-grade Chilean and Java ore. Prices vary from 65 to 80c. per unit, depending on the delivery and quantity. Of decided interest is the sale of 15,000 to 20,000 tons of Indian ore to a large American producer of ferro-manganese for delivery over the year commencing in June.

Manganese-iron Alloys: American makers of ferro-manganese have advanced prices from \$180 a week ago to \$200, delivered, sales being recorded at both levels. For spot delivery a limited amount is offered at \$250, delivered. Almost no British alloy is available now for any delivery and two British producers will have to delay shipments on contracts because of an unexpected shortage of ore in Great Britain. Spiegeleisen is active and higher at \$62, furnace. There have been sales of about 4000 tons for domestic and foreign account.

Ferro-manganese imports in February were 2939 tons against 2771 tons in January and 2752 tons per month in 1919.

Company Reports

BARNES-KING DEVELOPMENT CO.

Report for the year ending December 31, 1919.

Property: mines at Kendall, Fergus county, Montana; also a working option on the Plegan-Gloster mine at Marysville, Montana.

Operating Officials: George T. McGee, manager; J. H. McCormick and T. W. Heatherley, mine superintendents.

Financial Statement: during the period, March 1 to December 31, total bullion returns were \$4,179,533; miscellaneous income, \$127,289; total expenditures, including development on new properties in British Columbia, California, Nevada, and Idaho, amounted to \$4,445,584; funds available December 31 were \$75,842, in addition to \$50,000 in liberty bonds.

Dividends: \$120,000 was disbursed, making the total to date \$420,000.

Development: \$65,000 was spent in development of the Plegan-Gloster mine with disappointing results. None of the properties being developed under option are deemed worthy of purchase.

Production: the North Moccasin mine produced 25,843 tons valued at \$6.56 per ton, the Plegan-Gloster 11,917 tons at \$6.27 per ton, and the Shannon 36,740 tons at \$10.75 per ton.

DALY WEST MINING CO.

Report for the year ending December 31, 1919.

Property: mine and mill at Park City, Utah.

Operating Officials: G. W. Lambourne, general manager; O. N. Friendly, general superintendent; G. R. McKay, mine superintendent.

Financial Statement: proceeds from ore sales, \$179,910; sundry receipts, \$14,648; capital stock increase, \$140,000; total income, \$334,557. Mining cost, \$72,890; prospecting and development, \$87,597; total expense, \$216,205.

Dividends: none for past seven years. Total to date, \$6,606,000.

Development: 4928 ft. of exploratory work, from both Daly West and Judge workings, was done. No definitely important discoveries were made but indications are favorable.

Production: 3243 tons of ore on company account; 1546 from lessees and 1347 tons of concentrate and tailing were marketed. Company ore averaged \$34.97, while the other products averaged \$22. The mill was inoperative.

UNITED VERDE EXTENSION MINING CO.

Report for the year ending December 31, 1919.

Property: mine and smelter at Jerome, Arizona.

Operating Officials: George Kingdon, general manager; George W. Nicolson, general superintendent; James Heggie, smelter superintendent.

Financial Statement: gross revenue from metals produced, \$5,058,669; other revenue, \$406,256; total, \$5,464,924. Operating expense, \$2,771,592; miscellaneous expense, including taxes, \$569,309; written off to reserves for depletion and depreciation, \$2,359,180; total, \$5,700,080. Net loss to surplus, \$235,156.

Dividends: four quarterly dividends; total, \$2,362,500; total to date, \$11,130,000.

Development: 5578 ft. of development work included 167 ft. in the Edith shaft and 1233 ft. of haulage ways. The sump and pump-station below the 1700-ft. level has been completed. The estimated ore-reserves amount to 571,400 tons, averaging 15% copper, 0.025 oz. gold, and 3.0 oz. silver per ton.

Production: 96,546 tons of ore yielded 28,860,615 lb. of copper; the average selling price was 17.163c. per pound. The smelter was closed for four months during the year on account of a labor strike in the district. Costs were as fol-

lows: mining, 0.043c. per pound; smelting, 0.025c. per pound; freight on ore, 0.002c. per pound; freight on bullion and refining, 0.026c. per pound; outside expenses, 0.002c. per pound; total, 0.098c. per pound.

HECLA MINING CO.

Report for the year ending December 31, 1919.

Property: mine and mill at Burke, Idaho.

Operating Official: James F. McCarthy, general manager.

Financial Statement: ore sales (net receipts), \$1,617,230; interest, \$73,729; rents, \$1466; miscellaneous, \$345; total, \$1,692,721. Mining and development, \$599,194; ore sorting, \$41,849; ore hauling, \$20,353; milling, \$97,099; miscellaneous, \$174,643; total, \$933,139. Net income, \$759,632; depreciation of ore-reserves, \$133,092; net profit, \$626,539.

Dividends: for the year, \$600,000; total to date, \$7,855,000.

Development: consisted of 4449 ft. of drifts, cross-cuts, and raises. The principal piece of development for the year was done on the 2000-ft. level. In December the ore on this level was encountered at approximately the same point at which it was found on the level above (1600-ft. level). The quantity and quality of the ore is good and the development so far is in every way satisfactory. Ore-reserves are estimated at 1,549,833 tons without including any tonnage between 2000 and 1600-ft. levels.

Production: tons milled, 175,102; tons of crude ore shipped 7452; lead produced, 24,726,015 lb.; silver produced 795,058 oz.

THE MASS CONSOLIDATED MINING CO.

Report for the year ending December 31, 1919.

Property: mines in Ontonagon county, Michigan, and mill at Keweenaw Bay.

Operating Officials: Elton W. Walker, superintendent; E. Fenner Douglass, mill superintendent; A. P. Bennetts, mine superintendent.

Financial Statement: gross income, \$429,845, including 1,626,973 lb. of copper on hand inventoried at 19c. Expenditures for mining were \$488,045, and miscellaneous expenses were \$87,906. Cash assets on hand December 31, 1919, amounted to \$149,667.

Dividends: no dividends during 1919; total to date, \$500,000.

Development: 2404 ft. of development work was performed during the year and the ore-reserves are estimated to be as good if not better than at the end of 1918.

Production: operations were hindered by an inadequate supply of labor; 171,474 tons of ore was hoisted, 123,780 tons was milled, and 1,963,178 lb. of refined copper was produced. Cost of refined copper, exclusive of depreciation, depletion, and construction, was 27.83c. Average grade of ore milled was 24.2 lb. per ton.

GOLDFIELD CONSOLIDATED MINES CO.

Report for the year ending December 31, 1919.

Property: mines and mill at Goldfield, Nevada.

Operating Official: E. A. Julian, general manager.

Financial Statement: proceeds from the sale of bullion and by-products, \$170,142; received as royalties, \$41,292; total, \$211,433. Other income in excess of sum paid for ore, \$33,416; operating expense, \$109,433; \$350,000 on Aurora mine loan was written off during the year.

Dividends: No. 25 amounted to \$177,957, making a total of \$29,177,789.

Development: Goldfield Consolidated Mines Exploration Co., a subsidiary of the Goldfield Con. Mines Co., is developing various properties with a view to possible purchase.

Production: milling operations were finished in January; followed by a thorough clean-up of the plant, producing the income as given in the financial statement.

Book Reviews

Water Powers of British Columbia. By Arthur V. White. Pp. 620. Ill., index. The Canadian Commission of Conservation, Ottawa, Canada.

This report is a compendium of data relating to the water-power resources of British Columbia. The opening chapters discuss the general principles governing the conservation of inland waters. Then follows a historical survey of water legislation in British Columbia. Lists are then given showing the various possibilities of power development, followed by tables of stream-flow and meteorological and other hydrometric records. The volume closes with a bibliography.

Manufacture and Uses of Alloy Steels. By Henry D. Hibbard. Pp. 92. Index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$1.25.

This is a reprint of a monograph recently issued by the U. S. Bureau of Mines. After a general introductory chapter, the author considers in succession the principal kinds of alloy-steels, and gives a brief summary of the methods of manufacture, characteristic properties, and principal uses of each one, accompanied by a bibliography. While the treatment is so brief that occasional omissions of important facts are inevitable, the book should prove of value to anyone interested in the subject.

Hydrology. By Daniel W. Mead. Pp. 626. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$5.

In this volume, Professor Mead has increased the debt that the hydraulic engineers of America, and for that matter of the whole world, owe to him. Every aspect of the subject is discussed thoroughly and each chapter closes with a reasonably complete bibliography for the use of the engineer that wishes to pursue his studies further. The various meteorological factors affecting rainfall are discussed in turn, and this is followed by a consideration of the factors affecting runoff, with particular attention to the conditions producing floods on the one hand or drought on the other. The book is well-illustrated with photographs, maps, and diagrams. It will prove indispensable to the hydraulic engineer.

Timber: Its Strength, Seasoning, and Grading. By Harold S. Betts. Pp. 223. Ill. (together with several insert maps and charts), index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The title of this book should rather have been 'Timber in the United States', since it is devoted entirely to this country. The author is a member of the staff of the U. S. Forest Service, and has made liberal use of bulletins of the Service, both by himself and by co-workers. The book, however, is not a mere compilation, but an excellent short treatise on the subjects mentioned in the title. An interesting feature of the book is a description, illustrated by sketches, of the standard method for making the various tests of the properties of timber, including many tests that are not familiar to most engineers. It is interesting to note that the alarmist note sounded by many so-called forestry experts, particularly a decade or two ago, is absent in the present volume. The author frankly recognizes that, while the timber consumption and waste at the present time is considerably in excess of the replacement, there is every reason to suppose that substitution of other products, reduction of waste, etc., as well as reforestation, will change this condition before any actual timber famine occurs. Besides an introductory and a final chapter, both of them mainly statistical, the chapter-headings are: Strength of Wood, Effect of Moisture and of Preservative Treatments on the Strength of Wood, Strength of

Wooden Products, Seasoning of Wood, and the Grading of Lumber. The treatment is non-technical and entirely intelligible to the layman. It should be of value both to the user and the manufacturer of timber.

Prospecting for Oil and Gas. By L. S. Panyity. Pp. 244, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.25.

The first ten chapters of this book, comprising 134 pages in all, deal directly with the subject indicated by the title, and they are by far the most useful part of the volume. These chapters comprise a general discussion of the geological factors affecting the accumulation of oil, methods of surveying, and doing the other necessary field work. The treatment is necessarily brief but not so brief as to fail of being useful. The remainder of the principal part of the book is disappointing. It attempts to cover so much that it covers nothing at all. 'Scouting' is discussed in a chapter of 3 pages, and a total of 67 pages is devoted to Methods of Locating Wells, Drilling Methods, 'Bringing-in' Wells, Completion of Wells, Gauging Oil and Gas Wells, Increasing Production, and The Producer and Landowner. The result is that the treatment is so fragmentary that, for instance, the chapter on drilling methods does not even mention the use of cement for shutting off water. This latter part of the book had far better have been omitted and the space devoted to additional matter regarding the subjects treated in the rest of the volume. The appendix contains typical 'geological columns' in several oilfields and some mathematical tables.

Employment Psychology. By Henry C. Link. Pp. 435. Ill., index. The Macmillan Co., New York. For sale by Mining and Scientific Press. Price, \$2.50.

The psychologist just now is receiving the attention in the industrial world that was given to the efficiency expert a few years ago. Both have suffered because of the men that, after acquiring a smattering, posed as experts, and have suffered also because part, at least, of the general public has expected entirely too much from their work. If any reader of the present volume expects 'unduly important results from the work of the psychologist, it will not be the fault of the author, who is ever on the alert to point out the limitations of psychological methods not only in the hands of a novice, but even when used by an expert. On the other hand, he shows that carefully selected psychological tests and records can be made of great value, not only in hiring employees, but also in transferring, and even in 'firing', when that becomes necessary. The material in the book is based mainly on actual experience with the workers in industrial concerns. Part I is devoted to psychological tests describing the tests used and the results obtained in selecting both men and women for various kinds of factory and office work. Special stress is laid on the importance of suiting the test to the particular kind. In discussing the scope of psychological tests, the author gives his reasons for believing that tests cannot be developed that will be of service in selecting men for the higher executive positions. Part II deals with trade tests and other applications of employment psychology, and considers such subjects as the proper methods to be used by an employment manager in questioning an applicant, the analysis of jobs, and the field of the so-called vestibule school. Part III discusses selection and retention of employees, while Part IV gives the author's general conclusions regarding the application of psychology to employment problems, considered from the point of view of both the employer and the employee. The appendix describes several of the most commonly used tests as well as the methods to be used for rating the results. The book should be in the hands of employment managers and employers generally.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE SULLIVAN DRILL-STEEL FURNACE FOR OIL OR GAS FUEL

The efficient sharpening and tempering of drill steel has come to be recognized by mine operators as well as by drill manufacturers, as being an important factor in the success and low cost of rock excavation; and during the past few years, much has been done to improve drill-bits and drill-steel, in these respects. Since the introduction of mechanical



Fig. 1. Drill-Steel Furnace

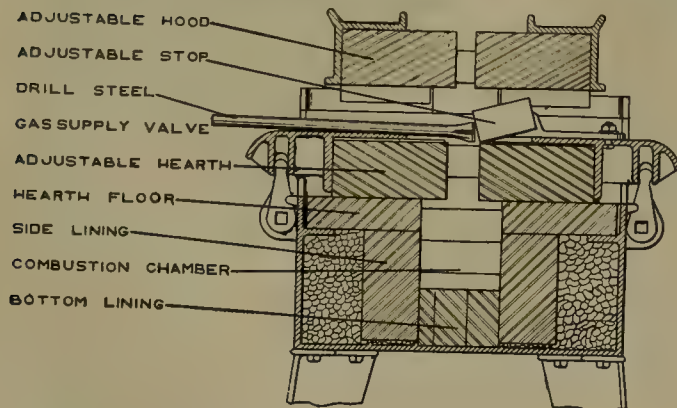


Fig. 2. Sectional View of the Furnace

drill-sharpeners there has been a demand for a steel-heating furnace, capable of supplying the necessary number of correctly heated steels, for machines of large capacity.

The Sullivan drill-steel furnace, shown in Fig. 1, consists of a rectangular cast-iron box, with a lining of fire-brick, having adjustable hearths and hoods, with a burner or atomizer attached at one end. The furnace is mounted on four legs, at a convenient working height. It is so designed that steels may be inserted from either or both sides of the

furnace at once, but it is recommended that only one side be used, as best results are obtained from this practice. An adjustable support carries the outer ends of the steels while in the furnace. The ends of the steels to be heated extend over the combustion-chamber, supported on the adjustable hearth, and abut against a movable stop of fire-brick. About twenty 14-in. bits may be placed in the furnace from one side, at one time.

The following features and advantages of the Sullivan furnace will be noted by those who have had experience with coal or coke forges and with other types of oil or gas furnaces.

(1) Uniform temperatures are secured without danger of overheating or burning. (2) Great capacity. (3) Economy of fuel and compressed air. (4) Adaptability to different kinds of fuel. (5) Flexibility, providing for adjustment to heat any portion of the steel desired. (6) Ease of adjustment and repair. (7) Low cost of maintenance.

When coal or coke is used in a forge, the maintenance of a uniform temperature over any considerable period is difficult, whereas with the oil or gas-furnace, with proper feeding and atomizing equipment, this becomes a simple matter. The Sullivan furnace is equipped with a burner for gas or an atomizer for oil, having pipe connections for compressed air and fuel. By proper regulation of the valves, a suitable mixture and quantity are obtained to secure a flame of the proper volume and intensity. When this regulation has been made, this part of the operation becomes almost automatic and requires little or no attention on the part of the operator, until a change of temperature for some other purpose is desired. By means of a suitable pyrometer, the purchase of which is always recommended as a part of the furnace equipment, the operator can maintain the temperature in the furnace at the proper maximum at all times, avoiding any danger of overheating the steel and thus burning and destroying the cutting and wear-resistant qualities of the bits. The importance of this feature cannot be emphasized too greatly.

Using one side of the furnace only, two Sullivan machines can be kept supplied with steel at forging temperature, by this new furnace. This means that a steel is taken from the furnace every 30 seconds. Still greater capacity can be secured, if the sharpeners are working on dull bits and not on new stock only, by heating from both sides of the furnace. This procedure would also be recommended if the two sharpeners are handling different kinds of steel. For instance, if one machine is sharpening cruciform stoper-bits, while the other is handling hexagonal or round hollow steel, the ability to work from both sides of the furnace, with the slight necessary increase in fuel consumption, is very valuable.

As will be noted from the above description, only sufficient fuel need be burned to produce the necessary maximum temperature. The combustion-chamber is so shaped, and the position and operation of the hearths above it, are such that every particle of heat generated is utilized for productive

work. The fire-brick lining absorbs a large proportion of the heat, and this is given off in reflected form with consequent economy of heat.

As stated, compressed air is used for atomizing the oil-fuel, and this is taken from the high-pressure supply-line, on which a reducing valve is placed, to provide air at a pressure of from one to five pounds, as required by the character of the fuel. The arrangement of the valves on the burner is such as to permit very close regulation, and no more air should be admitted than is actually required to produce complete combustion. The use of more air than this produces an oxidizing flame, causing the steel to blister or scale, and subjecting the lining of the furnace to undue wear. The oil and air-valves should be opened only sufficiently to maintain the heat required. Wider opening merely results in waste of fuel. Records carefully kept over a long period indicate that the normal fuel-oil consumption of this furnace is from 16 to 18 gallons per day of 8 hours, or approximately two gallons per hour.

The burner or atomizer employed is designed to handle gas or fuel and crude-oils of 20°B. or lighter specific gravity, without preheating. Heavier oils should be preheated, to assure a proper rate of flow to the burner. When oil is used, a compressed-air blast at low pressure is employed to atomize it.

Surmounting the combustion-chamber, which consists of an opening lined with fire-brick about three feet long, six inches wide, and seven inches deep, are two adjustable hearths, illustrated in detail in Fig. 2. These are formed by cast-iron brackets, containing a row of fire-brick. These hearths can be moved in or out to reduce or to widen the opening above the combustion-chamber, and in connection with the adjustable stop, permit the heat to be concentrated at the tip end of the steel for tempering purposes, over several inches of steel for making bits, or at any desired point on the steel, as in making shanks. The adjustable stop, formed of an iron holder containing fire-brick, is bolted on top of the hearth, and can be moved back and forward on it. This performs two functions, first to give an additional range of adjustability in heating the drill-steel at the proper point and in the proper length, and second, to form a rest or abutment in such a manner that the entire face of the bit as well as the side of the steel is heated thoroughly and evenly. It will be noticed from the illustration that the bricks in this stop are tilted so that only one edge or wing of the steel comes in contact with them.

As will be seen from the illustrations, the furnace is exceedingly simple in construction, and adjustments and repairs are readily made when necessary. The fire-brick in the hoods and hearths, and in the adjustable stops are held in place by screws and when replacements are needed these are made by loosening the screws and inserting the appropriate new brick.

The fire-brick lining is practically the only part of the apparatus requiring renewal, and as standard fire-brick are employed for this purpose, it is possible for the owner to secure and maintain a supply from his local dealer, without going to the expense and delay of securing special brick or linings from manufacturers. The use of carborundum bricks of standard size, which may be employed for the hearths, if desired, provides additional durability. Combustion takes place over the entire length of the combustion chamber of the furnace. The so-called cold end is that next the burner, and the hot or finishing end is that farthest from the burner. All steels are replaced in the furnace next to the burner, and are gradually moved toward the opposite end, in which the finishing temperature is maintained at a constant point, and from which the steels are removed to be taken to the tempering tank or the drill-sharpener. In this way, the steels are removed from the furnace on the 'rising heat', as soon as they are ready for use.

THE COST-PLUS METHOD

Westinghouse, Church, Kerr & Co., engineers and constructors, have for 20 years operated exclusively on the cost-plus basis. They argue that this method when properly used is the fairest to both builder and client. A manufacturer is taking contracts for his product at a price to be determined on delivery of the goods. With all the comparative certainty of overhead charges, quantity production, and other predetermined costs he is unable to set a price because of the uncertainty of the labor and material markets.

And yet some people expect an engineer and builder to guarantee the cost of a building—a made-to-order product, special, individualized, never before built. If the manufacturer is unable to set a price on his product it is reasonable to ask the constructor to guarantee the cost of his?

The company's advice to prospective clients follows:

"If you are planning work, pick out several organizations which you think to be qualified, compare them on the basis of record, experience, integrity, financial strength, methods and organization personnel, and give the work on cost-plus-a-fee to the company which can best satisfy you. Your interests are identical with his and his future is measured by the record he can make for you. He depends very largely on repeat orders from old clients and he can only get them by delivering a real service. This service means more than the production of just a building; it includes economical design—both as to first cost and cost of maintenance; speed of construction—for the sooner a new plant is put to work, the sooner it will be a producer; superintendence—of the driving, result-getting type; right purchasing; close follow-up of shipments and other facts entering into a building operation.

"And further—when you are selecting your engineer and builder for cost-plus work the size of the fee of itself may tend to influence you. But look deeper. The high fee of one organization may be a better buy than the lower fee of another, not only because of a possible different definition of costs on which the fee is computed but because of an essential operating efficiency—obtainable through long experience in cost-plus work—which the former company may have over the others. In other words the company asking the larger fee may be able to do the work at less total cost. Total cost is the important factor, not size of fee. We have in the past from time to time encountered those who had had unfortunate experiences with cost-plus builders. And it always developed that it was the fault not of the method but of the constructor using the method. Successful cost-plus work hinges upon the integrity and ability of the builder. Choose him with the greatest care. Search his record and experience. Study his definition of costs. Find out his percentage of repeat orders from old clients—an unfailing indication of service rendered. Meet his officers and principal engineers, and when you are thoroughly satisfied put yourself in his hands."

In 'Graphite', published by the Joseph Dixon Crucible Co., appears the following advice on the treatment of belts: "As a belt depends entirely on its power of adhesion to the pulleys to perform its function, see to it that its power of adhesion is maintained at the maximum by not overloading, and by the consistent use of suitable belt-dressing, sparingly but regularly applied. Do not allow the dressing to clog on the pulleys. As belt-slip is an insidious danger—it makes no noise—and may be going on unsuspected until irretrievable damage has been done to the belt, begin the application of belt-dressing immediately the belt is put in use. There are several good dressings on the market, but Dixon's solid belt-dressing has no superior. For preserving the life and pliability of heavy leather belts use Dixon's paste belt-dressing. Write for free booklet No. 190-O, 'The Proper Care of Belts'."

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Dewey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, APRIL 17, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	557

TO YOUNG ENGINEERS	559
--------------------------	-----

Mining—an art to which the sciences are applied. The impression made by appearance. Not democratic to be slatternly. Specialization. American enthusiasm. Possibility of overdoing a good habit. Starting as surveyors and chemists. Co-operation, and loyalty to the employer.

THE SEATTLE CONVENTION	559
------------------------------	-----

Scope of the Convention. An established custom. Iron and steel industry on the Coast. Resources. The status of the gold-mining industry. The speech of Mr. Emmet D. Boyle, Governor of Nevada. Need for deflation. Mr. Frank A. Vanderbilt's contrary view of the problem. The danger in the proposed 'remedy'. He urged the need of a national and an international attitude. The resolution endorsing the legislation pending in Congress carried without dissent.

ARTICLES

INCIDENTS IN A MINING ENGINEER'S LIFE

By E. T. McCarthy..... 561

Native life in Mexico near the Guatemalan border. The mining engineer as a surgeon. Getting along with the native. South African experiences. A disastrous ride. In China. Some Chinese metallurgy. Sportive elephants in the Malay States.

MINE AND FLOTATION-PLANT OF THE AMERICAN GRAPHITE COMPANY, NEAR TICONDEROGA, NEW YORK

By C. E. Chaffin..... 567

Brief history of the graphite industry in northern New York. Geologic features. Mining methods. The concentrator. Crushing and grinding. Flota-

tion equipment. The flow-sheet. Peculiarities of flotation technique. Grinding difficulties. Refining the concentrate.

MR. MacNAUGHTON'S ADVICE TO STUDENTS

By P. B. McDonald..... 570

An honorable and dignified profession—mining engineering. Beware of high-topped boots and an excess of hair. Specialization and success. The graduate is a liability to his employer at the outset. Starting as trammers. Loyalty.

MINERAL PRODUCTION OF CANADA DURING 1919

By J. McLeish..... 571

Opportunity for exploitation. The record of the past six years. Copper and nickel production. Copper Mountain and Hidden Creek. Gold and silver production. Sources of gold. Lead and zinc. Future prospects are encouraging. Miscellaneous products.

FORMULAS FOR DETERMINING THE TONNAGE OF PRODUCTS FROM METALLURGICAL OPERATIONS

By A. H. Heller..... 575

The calculation of the tonnage of metallurgical products having given the quantity and metal contents of the original material and the analyses of the products themselves. There must be assays for two or more metals. Applicable to both mill and smelter operation.

NOTES

ACCIDENTS AT METALLURGICAL PLANTS.....	574
--	-----

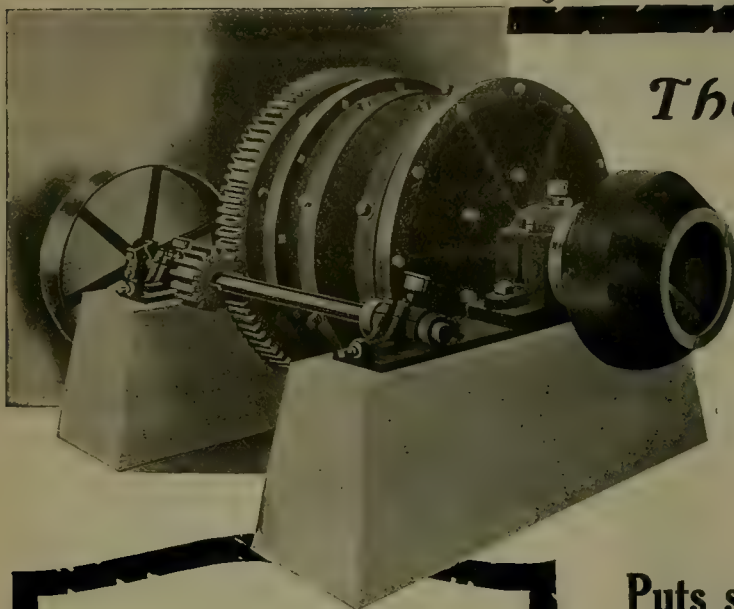
DEPARTMENTS

REVIEW OF MINING	577
THE MINING SUMMARY	585
PERSONAL	586
THE METAL MARKET	587
EASTERN METAL MARKET	588
INDUSTRIAL PROGRESS	589

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.



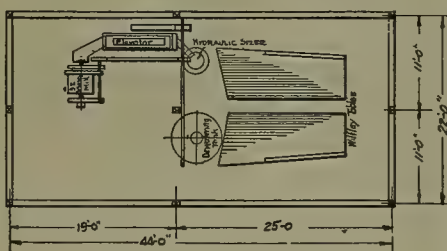
The "Baby"

**MARCY
BALL MILL**



An example of

Baby "Marcy" Performance



Typical layout for an efficient 10 ton plant.

Feed is medium hard quartz crushed to 1½ in., charge of balls 500 lb. (usual charge 800 lb.) Grinds through 8 mesh—1½ tons per hour. Operator says: "We have never had the full charge of balls in the mills as our table capacity will not care for more than 1½ tons per hour. I feel safe in saying that with a full load of balls and the feed 1 inch and smaller the mill will handle fifty tons per twenty-four hours."

Puts small tonnage plants on a basis approaching large tonnage efficiency.

The plant putting through a low tonnage need not be under a great cost handicap compared to the big plant with its capacity in thousands of tons per day.

Not if the small plant has called in the "Baby" Marcy Mill and the "one-easy-step" system. It brings "Big" Marcy efficiency and "one-easy-step" savings to the door of the smallest tonnage plant.

The little No. 32 Marcy Mill is ideal for plants around 10 to 15 tons capacity (it can handle much more); requires 4 H. P.; has all the features of its big brothers No.'s 43, 54, 64½, 75 and 86 Marcy Mills.

Marcy Mill capacities run from 10 to 500 and more tons per day.

Write for Bulletin 42.

The Mine & Smelter Supply Company

A Service Station Within Reach of You

DENVER

SALT LAKE CITY

EL PASO

New York Office: 42 Broadway

Pacific Coast Representative—Harron, Rickard & McCone, San Francisco and Los Angeles



T. A. RICKARD, - - - Editor

THE production and distribution of agricultural products is vital to our national welfare. If you want to know what the present problems are, to understand the dangers that surround the industry, to see the relations it bears to other industries; if you want the keenest analysis of essentials, and the most common-sense solution from the best informed, straightest thinking, and farthest seeing man in the world today, read the leading article in the 'Saturday Evening Post' of April 10, 'Some Notes on Agricultural Readjustment and the High Cost of Living' by Herbert Hoover.

REGULATIONS for the prospecting and leasing of coal lands under the recently passed Mineral Land Leasing Act have been announced. Any qualified person or corporation is entitled to lease not more than one tract of 2560 acres in a particular State, and competitive bidding will determine the allocation in the event of two applications for lease of the same tract. A minimum royalty of five cents per ton is provided. Permits may be granted applicants to prospect undeveloped lands, with the provision that the prospector may subsequently lease the tract at a royalty to be fixed by the Government, through the Secretary of the Interior, who is the administrator under the law. Exception is made of coal deposits in Alaska, the National parks, the Appalachian forest-reserve, and the military and naval reservations.

A LARGE proportion of the many ventures in graphite mining in the United States have been unsuccessful. Conspicuous among the few fortunate enterprises is that of the American Graphite Company, whose operations in the vicinity of Ticonderoga, New York, are described on another page by Mr. C. E. Chaffin, a member of the staff of the General Engineering Company. The difficulty generally has been the problem of concentrating the ore, and inability to do this successfully accounts for most of the failures. The separation is an art involving delicate manipulation. Minute variations in the physical and mineralogic characteristics of the ore necessitate changes in the scheme of concentration; in fact two apparently identical ores may require entirely different handling, and quite frequently the treatment of one of them has proved too much of a problem for the millman. Graphite has a specific gravity of only 2.15, so that the familiar processes of concentrating metalliferous ores are obviously reversed in that the heavy mineral is discarded

and the light saved. Micaceous minerals on account of their flaky nature are particularly aggravating, as they naturally tend to float off with the graphite. Moreover, the problem is not simply to obtain the highest extraction of graphitic carbon, but rather to recover a maximum proportion in the form of high-grade, large-size flake. This is the material suitable for the manufacture of crucibles to be used in steel-plants, brass-foundries, and similar industries, and being the product most in demand brings by far the higher price. Several methods of concentration were formerly in vogue. 'Surface-tension' washers of various types; shallow circular buddles in which the ground ore was separated into distinct zones with the concentrate at the periphery; dry pneumatic concentrators; and electrostatic separators were used with varying degrees of success. However, the development of froth flotation and the scientific application of the process to the treatment of graphite ore has displaced most of the former methods.

IN this issue we give our readers some excerpts from Mr. E. T. McCarthy's reminiscences, as published recently in his most interesting book. To them we have added a few humorous sketches. It will be noted that our artist has not the pleasure of Mr. McCarthy's acquaintance nor has he seen that author's photograph, which hangs in our editorial sanctum; otherwise he would not have taken such dreadful liberties with his face and figure! The remarkable specimens of natural history that Mr. McCarthy saw in the course of his travels will provoke keen interest, coming as they do from a man with so little of the Munchausen about him, but the two best items are the description of Chinese practice and the cogitations on the treatment of tough characters, on the third page. The book itself, which we again venture to recommend highly, contains many such humane and sagacious observations on those whom, as an engineer, the author employed in various countries.

FROM Denver comes an item of news that would be highly important if it were true. Mr. Elihu Palmer is reported by the Intermountain News Bureau to have predicted "the possibility that the American nation will enjoy soon sufficient wealth in gold and silver to pay the War debt, and much more", thanks to the "discovery, declared to have been made by chemists and metallurgists of this city recently that the oil-bearing shale-beds

are rich in precious metals". This is a yarn that has been repeated by irresponsible persons on various occasions during the last twelve months. Mr. Palmer explains that "revealing of these storehouses of wealth, which are surpassingly sensational in the prodigious quantity of gold, silver, and platinum the discoverers credit them with containing, appears to have been delayed until now only because the alchemists have not understood the combinations to the locks behind which King Midas has been hiding these treasures, likely throughout civilization". The last clause is cryptic and the remainder is flapdoodle unworthy of "release for publication" on any date. We are reminded of the celebrated brewery that was described as "a potentiality of wealth beyond the fondest dreams of avarice", but even a brewery in these days of prohibition seems to us a more likely source of money than these "oleagenous shales" as Professor (he must be a professor, to give the story local verisimilitude) Palmer calls them. "Confirmation of the entire discovery by numerous experts", it is asserted, was delayed until nature's secret was penetrated and the alchemists of Denver had ascertained the strange fact that "the shales must be relieved of their oil-creating hydro-carbons before they will respond favorably to ordinary assayers' practices." How many hydro-carbons were there and how does an ordinary assayer differ from an alchemist? Is the subsequent process of publicity and share-peddling likewise intended to "relieve" the simple-minded of their excess of something more tangible than hydro-carbons? Samples are said to have "given up gold, silver, and platinum only after having been completely decarbonized and oxidized while being subjected to a process designed to merely extract all the oil, gas, and ammonium sulphate". Next, presumably, will follow the even more fascinating process whereby the gullible will give up their gold and silver, and possibly their platinum-set jewelry, after having been completely bamboozled and spifficated while being subjected to a method of spoofery designed to extract not merely their spare cash but their bonds and mortgages. To come to brass tacks, the oil-shale is said to yield \$15 per ton in three precious metals, although "many stratas" [weird things!] are "laden" with \$40 per ton, and only a few "as low as \$5 per ton". Moreover the additional cost, after distillation for oil, will be \$2.50 per ton for the recovery of gold, silver, and platinum. In the name of Shadrach, Mechach, and Abednego, or any other trio that underwent distillation by fire, how much money is there in the shale deposits of the West? Mr. Palmer tells us without hesitation; he quotes the U. S. Geological Survey estimate of sixty billion tons in Nevada, Wyoming, Utah, and Colorado, and on the modest basis of \$10 per ton, he finds their potential oil-value to be 600 billions "net". Then, adding the "precious-metal value", he finds a sum so large that he has to write it out, "one trillion five hundred billion dollars". What is the use of talking about aiding ordinary gold mining; here is a source transcending even the ocean, which, as everybody knows, contains gold in solution, or the moonbeams, which are made of silver.

Thus from shale is distilled a tale of the Arabian Nights and from the kerogen a yarn more smooth than vaseline.

MINERS of bituminous coal are now receiving 27% more for their work than was provided in the wage-scale in effect prior to November 1, 1919. This is the outcome of the award made by the President's Bituminous Coal Commission, that was ratified by the general scale committee of operators and miners in the central competitive field on March 31 and became effective the day following. The increase of 27% is substituted for the advance of 14% allowed by Fuel Commissioner Garfield when the strike was threatened last winter. The 14% increase added 104 million dollars to the cost of coal production; the new arrangement increases that amount to 200 million. According to the operators this will add from 65 cents to \$1.25 per ton to the cost of coal to the consumer; the representatives of the miners on the other hand contend that the additional wages will increase the cost of production by only 25 cents per ton and that the companies can and should absorb this by decreasing their profits. However, since the President is not inclined to make use of the power conferred on him by the Lever Act to continue the old, or establish a new, maximum price, and since there is an appreciable shortage of coal at the present time, prices will doubtless advance considerably above the Government standard of \$2.95, in effect prior to April 1. The contention of the miners that the working day be established at six instead of at eight hours, was denied by the Commission, on the seemingly tenable grounds that such a change would simply aggravate the present undesirable conditions and that it would be detrimental to the best interests of the mine workers, no less than of the public. In its report the commission concedes that any wage settlement is not an adequate solution to the coal-mining problem. The industry, as has been repeatedly pointed out, suffers from the fact that the quantity of coal burned during the winter months far exceeds that used in summer. Heretofore the policy has been to regulate production to synchronize with current consumption, and the result has been a seasonal variation in output that necessitated an unsound and inefficient organization of the whole industry. The difficulty is complicated by the problem of distribution as indicated by the fact that 49% of the time lost by miners was charged to 'car-shortage'. Stated simply, the solution is to mine and distribute a large part of the winter's supply during the summer. The three groups of consumers that require the greatest amount of coal are the railroads, the public-utility corporations, and the steel-plants. The first two classes operate largely under the regulation of various rate-making authorities and it is reasonable that added costs arising from the storage of a winter coal-supply be recognized in determining what service-rates may be allowed. By the proper application of this principle an adequate incentive might be offered to these corporations for obtaining surplus coal during the summer months. It is one thing to urge any group, by way of gratuitous public benefaction, to lay in its supply of

coal ahead of time so that the miner, the coal operator, and the rest of us would have smoother sailing; it is another thing to say to that same group, "If you will help out by spending the necessary money to put a supply of coal in storage and thus relieve a situation detrimental to all concerned, the public will make good your expenditure." Here is a good place to make a start; the detailed procedure is not essential.

To Young Engineers

On another page we publish an abstract of an address delivered recently at the Michigan College of Mines by Mr. James MacNaughton, manager of the Calumet & Hecla. This abstract is accompanied by sundry sympathetic remarks by Mr. P. B. McDonald, himself a graduate from the excellent mining school at which the address was given. Yes, mining is an art to which the sciences are applied; being based upon science, it is founded upon truth. Make-believe, in any guise, is its undoing. With Mr. MacNaughton's remarks on an apparently trivial matter, namely, personal appearance, we agree heartily. Men form impressions of one another first by appearances. It has ceased to be manly to be uncouth, either in clothes or manners. Time was when we in the West were on the frontier; we dressed like cowboys and talked a little like bad men from Kokomo; all that is out of date. There lingers an idea, among young men in our Western universities, that it is manly to be rough in speech and democratic to be slatternly in attire. At the University of California students in dirty corduroys fancy themselves suitably garbed for study in buildings of great architectural beauty and adornment. This is neither manly, nor democratic, nor American; it is simply provincial and ridiculous. It becomes neither a democrat nor an American to be boorish in speech, clothing, or manners. The American boy ought to be as well spoken, as decently dressed, and as gently mannered as any son of a duke but 15% more intelligent; that is the mark of a democrat, not a disregard for the amenities of civilized life. Next we turn to Mr. MacNaughton's reference to specialties. Undoubtedly concentration of effort is needed to promote proficiency in any one subject. The young American has the ability to devote himself enthusiastically to his professional work, and that is why, on the average, he becomes a competent engineer sooner than his contemporaries in other countries. We question, however, whether he is in need of urging that way; our own observation leads us to believe that he overdoes it already, becoming a specialist before he is educated and a technician before he is a scientific man. Even a good habit can be overdone. A broad training and a generous culture must be acquired when young, if at all; in them a man finds not only the development of capacity but a means of happiness. It is a mistake to specialize too soon. One can sacrifice much by being in a hurry to make certain of a bread-and-butter sufficiency. That is where a technical college, like the one at Houghton, may fail, as compared with a university like Harvard. Read Huxley's inaugural address at the opening of Johns

Hopkins University. The end of any college training should be moral worth and intellectual clearness, not the winning of a small salary immediately upon graduation. It is rarely indeed that a graduate just hall-marked with a degree is competent to give a full return for his pay. He is, as Mr. MacNaughton says, "a liability to his employer for awhile". He should remember that "for awhile" after he becomes worth more than his pay, as he soon will if he puts his head and his heart into the job. As to becoming surveyors and chemists, Mr. MacNaughton is right. These jobs are often mere *cul-de-sacs*; they may lead nowhere, unless they are combined with other work. A chemist in a smelter may get a chance to learn the technique of furnace operation and so become a metallurgist; a surveyor may consult daily with the mine superintendent until he acquires a knowledge of ore-finding; the thing to avoid is a comfortable subsidence into any mechanical task, such as surveying or assaying. Use them as doors or stepping-stones to something better; and that means a job involving the direction of other men's labors. Finally, be loyal. Be true to yourself, your traditions, and your ideals; then to those who befriend you and trust in you. Cheerful co-operation and intelligent loyalty are fine qualities; they are highly appreciated by those who employ young men; they are the qualities that in turn are essential to leadership among men. That is the aim and purpose of any special education: to produce men of originality and initiative, useful in their day and generation, and pioneers of human progress.

The Seattle Convention

The plan of holding an annual international mining convention in the North-West is now established, the second meeting, at Seattle, having proved a decisive success. Last year the mining fraternity along the border met at Vancouver; next year they will assemble at Portland. This convention is called 'international', but essentially it is Canadian-American, and, more precisely, it represents the mining activities of the States of Idaho, Washington, and Oregon, the Province of British Columbia, and the Territory of Alaska. It is true, the opening ceremonies at Seattle were graced by representatives of Chile and China; moreover, the slogan of that meeting was "the rim of the Pacific", and in furtherance of this idea we were told about the mineral resources, and the commercial exploitation of such resources, in the countries bordering the Pacific Ocean, but the dominant note of the meeting was goodwill and co-operation between the peoples on the two sides of the 49th parallel of latitude. A common purpose brought the English-speaking miners of a vast mineral region into harmonious deliberation and discussion. The convention was opened auspiciously by an admirably brief and appropriate speech by the chairman, Mr. Glenville A. Collins, to whom the success of the affair is largely due. The Mayor and the Governor were likewise crisp and to the point. The Bishop of Alaska talked the mining language like a 'sourdough' and Mr. E. T. Hodge responded for

British Columbia in felicitous phrase. As a geologist, he dwelt upon the fact that the continuity of the Cordilleran mining belt is unbroken from Chile to Alaska, the international boundary making no break either in the ore deposition or in the joint activities of the peoples along the border. The possibility of establishing an iron and steel industry on the Coast was the subject of the first regular session, the principal paper being read by Mr. Milnor Roberts, of the University of Washington. Three 50-ton open-hearth basic furnaces are in operation at West Seattle, besides a bushelling furnace of 1000 tons capacity per month and appropriate rolling-mill equipment. Magnetite and bog ore are said to be available in quantity, and coke is being made from local coal. An excellent summary of the coal resources of the North-West was given by Mr. Joseph Daniels, also of the State university. He brought out the fact that the countries on the opposite shores of the Pacific are vastly richer in coal than those on our own side, but he showed that the North-West has ample supplies of fuel, not to mention the water-power from which electric energy is obtainable for direct smelting.

Undoubtedly the overshadowing topic of the Convention was the restoration of gold to its normal status and the stimulation of its production at the mines. Occasional reference to the American discount on the Canadian dollar called forth a smile. It does seem unnecessary and ungenerous to show such financial inhospitality to the currency of our neighbors with whom we do a profitable business, more particularly as nine-tenths of the capital in British Columbian metal-mining enterprises is American, but it may be noted that the Canadian miner can, and does, obtain the benefit of the premium on his gold at the expense of his own fellow-citizens. Of the speeches made on the 'gold problem', two were especially noteworthy. Mr. Emmet D. Boyle, the Governor of Nevada, spoke for the miners. Formerly a miner himself and with recollections of experiences at Rossland, he was able easily to place himself in touch with his audience, which responded warmly to his sallies, especially his vigorous onslaught upon those most unpopular persons, the economists. He gave an account of the successive conferences called to consider the status of gold, beginning with the one that he himself called at Reno in August 1918, together with the reports of the various committees appointed to investigate the matter. The Armistice checked the efforts that had been set in motion to remedy the plight of the gold-mining industry, but the collapse of international exchange and the continued rise in the cost of living had revived interest in the subject, which was now expressed by a bill before Congress to impose an excise tax of \$10 per ounce on gold used in industry, that is, for jewelry, dentistry, and the like. The payment of a flat bonus the Governor recognized as unsound; it would strike at the foundations of credit and only make confusion worse confounded. The consumption of gold in industrial arts in the United States exceeded the production of our country in 1919 by 20 million dollars; the jewelers sold it at \$145 per ounce

when manufactured; therefore they could well afford to pay the \$10 tax, which would be given to the domestic producer of new gold. Other speakers, notably Mr. John Clausen and Mr. E. G. Crawford continued the discussion over two sessions. The enormous inflation of note-issues and other forms of paper currency was acknowledged, and the need for an orderly process of deflation was emphasized. The world was facing "the cold gray dawn of the morning after" its orgy of fighting and spending. At the last session Mr. Frank A. Vanderlip made an interesting appearance. He was on his way to the Orient and was to sail next day. His remarks came as a douche of cold water on the meeting, for he took a stand wholly unsympathetic with Governor Boyle and his mining friends. Mr. Vanderlip has the prestige of a national reputation and the experience of a trained publicist. He spoke well and with a frankness that did credit to his moral courage, for he was quite aware that his views were unpalatable to the audience. He sketched the evolution of paper money and the effects of the Federal Reserve banking system, emphasizing the enormous growth of the credit structure. There was nine billion dollars worth of gold in the world; the increase of output from the mines would bear no relation to an amount so large. There was three billions of gold in the United States, and we did not need any more; it would only serve as an excuse for further inflation of credit, for under the Federal Reserve system it would be legal to increase the purchasing medium at a ratio thirty times the amount of gold. We must cut down credits, he said, and increase the production of things other than gold. The miner was not the only man to suffer; the depositor in the savings banks and the holder of life insurance could only buy today two-fifths as much as his deposit or his premium purchased before the War. We must stop further credit expansion; we must learn to think nationally and internationally; we must get beyond making great decisions on personal relationships. The temperature of the hall had fallen until one recognized that it usually served as a skating-rink, but Mr. Vanderlip received a polite appreciation of his manly utterance, philistine as it seemed to the brothers of the pick and pan. They were soon warmed again by the Governor from Nevada, who proposed a resolution endorsing the legislation pending in Congress for the imposition of an excise tax on gold for the benefit of the miner. He demurred to the notion that gold was dedicated to the purpose of supporting credit; it was a commodity as well as a monetary standard; those who use gold for a commodity purpose ought to buy it on a commodity basis, not on the basis upon which it is required by the Government for money. The resolution was put to the meeting and carried without a dissenting voice. A number of other resolutions were passed, but we defer comment upon them until next week. In closing, we must not fail to acknowledge the generous tribute paid by Governor Boyle to the efforts made by the 'Mining and Scientific Press' to promote the investigation and discussion of the subject to which he himself has given so much earnest study.

Incidents in a Mining Engineer's Life

By E. T. McCARTHY

[In our issue of January 31 we reviewed the second volume of 'Incidents in the Life of a Mining Engineer', a book written by Mr. McCarthy for the purpose of raising money in behalf of the St. Dunstan's Hostel for the Blind, near London. We referred to the unpretentious style and keen interest of his recital of experiences in many lands. Herewith we publish sundry excerpts, to which we have added some humorous sketches by our artist. The first excerpt describes life in Chiapas, Mexico, near the Guatemalan border.]

The one great amusement of the natives, outside gambling, was to collect on a moonlight night on our little plaza outside the store and dance. On moonless nights for a special treat I would sometimes give them a couple of pounds of candles; these they would stick about, and dance for hours like happy children. There were always a few who could play the guitar. The Mexicans are a musical people, and very fond of anything in the way of a guitar, violin, or banjo. The Guatemalans favored their national instrument, the marimba. This is an instrument played by three or five performers, who, with slender sticks ending in little india-rubber balls, beat its notes by striking on a series of graduated hard pieces of wood strung along two strings, much as on a glorified kind of child's glass piano, but here the glass-notes are replaced by wooden ones. Under each wooden strip, or note, is attached a gourd or inverted pyramidal pointed box, graduated in size so as to respond to the corresponding note above it, and near its apex a small hole is bored, over which is gummed a fine membrane. These boxes thus serve as a sounding board. Some of the larger marimbas have as many as 48 notes. The wooden strips run from about five inches to ten inches in length, one to two inches in width, and are about three-eighths of an inch thick, each strip very slightly concave on its upper surface. To get the exact tone out of them, the final adjustment is made by filing away their outer edges, a mere scraping being sufficient to tune them up when once the instrument has been regulated. The music from it is sweet and plaintive, being in the minor key. The Guatemalans also play on a wooden harp, crudely constructed and not unlike the Irish harp in shape. Our dances were orderly, and conducted decorously, which was a marvel to me knowing the elements that went to make them up.

* * * * *

While sitting on the verandah of my house one evening, soon after my arrival, as I turned to look down over the plantation, I saw innumerable bright little lights rising out of it and coming up slowly in my direction. What they could be I had no idea, unless they were the spirits of the dead. So uncanny was this miniature star-like floating firmament that I hastily ran out to call one of my

staff to ask him what it could mean. To my enquiry he said, "Oh, they are the fire-beetles." Fire-flies I have seen by thousands, but never any creature so brightly illuminating the air. Slowly they came up, and were wafted over us; I secured a couple of specimens, and put them under an inverted glass placed over a book. I could by their light distinctly see to read every word of the page on which they rested. This beetle is peculiar to the States of Chiapas, Campeche, and Yucatan. Immediately above its eyes are two little lights, about the size of a large pin's head, and with a light as bright in comparison for its size as any electric light, whilst under the thorax and extending for about a quarter of its length a light is emitted, similar to that of a fire-fly (that is,



HOW TO USE FIRE-FLIES

phosphorescent), but more intense, and covering a much larger area than in the case of the latter insect. The mystery was solved, and night after night for about three months these sort of lost souls used to come floating up over the hill. The Indians commonly use them as lanterns by placing a few in a small wicker basket, which they tie to the end of a stick, and hold over the trail to light their way by. The beetle itself has a long and narrow body, and is of a light-brown color, about three-quarters of an inch long and three-eighths of an inch wide. It seemed to use its wings only to rise with, and then, using them as a sail, floats along on any little current of air that may be about. Where they went to and what became of them I never was able to trace, nor did I ever see them returning, though perhaps they may have done so later in the night.

Another peculiarity about them was that immediately below the thorax there was a curious little bony projection forming a tiny bar; the women used to fasten a piece of cotton to this, and tie the other end of it to the head of a pin, which, sticking in their hair or dress, allowed the beetle to crawl about and decorate them with its soft light. I was told that in the season in Mexico City there was quite a demand for these beetles, which

were sent from Yucatan to the jewelers there, who gave about one shilling to two shillings a piece for them. These the jewelers would take, and, substituting the cotton and pin with a very fine gold chain and hold-pin, sell to the ladies for the same purpose. I have never come across any description of these beetles in any magazine, and the references made to them in natural history encyclopedias give little idea of how bright those little lights are, especially the ones over the eyes, forming, as it were, a kind of port and starboard light. I have kept several alive for weeks by feeding them on sugar-cane, and made many attempts to send live specimens home through the post, either in match-boxes, or in a hollow piece of sugar-cane, but, although the boxes and cane arrived home, they were always empty, the postal authorities having doubtless discovered the presence of the beetles by the little gnawing noise they make. I have myself often used one of those wicker-work cages to show me the trail.

At a little distance from my hut I had a favorite bathing pool just beneath a little waterfall. In it was another of Nature's curiosities, little fish about two-thirds the size of a common sprat. These used to come to the surface, and shoot out from their mouths little globules of water at small flies or mosquitoes, and unerringly knock them down from a distance of about two or three inches; these they quickly swallowed. I have watched them by the hour and seldom scored a miss against them; to me they were always most fascinating.

Another of Nature's wonders was a species of bat, but not of an interesting kind, for they were the plague of my life. At our mule station at the mine and the one beyond, these creatures used to attack our mules at night. The method of attack is to flutter their wings gently over the mule's neck while they suck its blood from the jugular vein. In the morning the only sign of their having done so is a small dry stain of blood, hardly noticeable unless looked for. Night after night they would so attack the mules, with the effect that gradually they lost weight and got thin. At first we used to change the mules frequently with those at the lower stations, and so give the poor creatures a chance to pick up. From one of the directors of the Tolima mine, in Colombia, where they had similar trouble, I got a good tip which, when put into force, proved effective. The remedy was to enclose the stables (on account of the heat they had to be open ones) with ead screening used on the mill, and to hang up thorn brushwood above the mule's backs as they stood in their stalls. If by chance then any bats succeeded in getting into the stable they got entangled in the brushwood. Thus in a simple manner we got over a plague that had proved quite a serious matter.

During my sojourn here, as we had no medical man we had to be our own doctors and surgeons. The assistant-manager was more of the latter than I was; I hated the work. In stab-wounds and sewing up cuts we were both pretty good. The Chemula Indians, who cut firewood and roughly squared logs, also timber for the mine, were always cutting themselves about the legs, and they

gave us the most trouble, for their skins were so thick and tough—more like pig's skins—that we failed to get a needle to pierce them until we hit on a dodge which



SURGERY FOR NATIVES

acted admirably; this was to take a fine bradawl and bore the holes with a piece of cork placed beneath the skin, and then to pass the needle with the gut through them. I used to abominate this job, but it had to be done. They were either stoical or had no feeling, for they never flinched an inch under the operation.

These same Indians were fairly numerous in our district, physically a sturdy, broad-shouldered, well set-up people. No one could induce them to enter the mine; during the time of my management only one ever did so. They were truly hewers of wood and drawers of water. They spoke a language that, to my ear, was unpronounceable with its multiplicity of consonants clustered together, apparently with the minimum number of vowels that could be used to produce a sound. In features they were not at all unlike the Northern Chinese, and as brown as berries. They still refuse to pay taxes to the Mexican government, and they allowed no foreigner to enter their villages. I frequently asked some of the oldest of our workpeople if they would receive me in their village, but they always said they had to do as their Cacique instructed them, and therefore could not. The loads they carry were actually equal to those we put upon our pack-mules, or 240-lb. weight per man in the hilly country, and these were not merely carried short distances, but over long ones, 15 to 25 miles being about a day's journey, varying according to the steepness of the hills. These loads they perched on a wooden frame-work strapped to their backs.

* * * * *

Our head blacksmith was a well-known desperado, who more or less terrorized the camp; a good blacksmith himself but no good in controlling others under him. I had sent for an English blacksmith, but had told the former that, while his pay would not be reduced, he would be under the new man when he arrived. As I was dressing one morning, and had just finished putting on my coat, a knock came to my door, and the blacksmith walked in

without permission. I noticed he had his *poncho* on; it was a hot day, and unusual to see him in it. I had a big table in the room, and divining he might be up to some mischief I kept it between him and myself, walking slowly round it as he came round. He was arguing about his position. I told him to clear out and go down to the office, where I would be in ten minutes, when I would discuss the matter with him. He went out as told, and a few minutes afterward I left my room and was walking down to the office when I saw my second blacksmith staggering up the hill toward me, then falling down. We picked him up, and carried him into a house near-by, where he died ten minutes later. There was no sign of blood about him, but on stripping him there in the groin was a stab. Then it came out that the head blacksmith had gone up to him, held out his right hand to shake hands, and called him "*amigo*"—that is, friend—and as they clasped hands, he, with his left one, drove his knife into him. I sent for our chief policeman and ordered him to arrest the culprit, but he assured me that there was not a man in camp who dared to, and besides, if anyone dared, the camp would liberate him. So I walked down to where the man had gone, and told him to give me his knife. That knife in the first place had, I felt sure, been meant for me, and had been hidden under his *poncho*. I felt quite confident he would obey me, and had no fear of him. He did as he was told, and personally I locked him up in the jail. The same day I sent him to the police authorities, but in two months he was out of prison, and wrote asking me to reinstate him. His friends had collected about £20, and had bought him off.

The authorities came up after the murder, and demanded a *post mortem* on the victim. We had no doctor within 100 miles or so, but I bluffed them. I had my Red Cross certificate, signed by Earl Granville; this I produced, and expatiated on his name and signature, and pointed out the Red Cross on it, so that they were persuaded I must be a qualified surgeon. Forthwith we exhumed the body, and before them, by the light of two candles, we, the assistant-manager and myself, dissected the wound, a mere formality. The absence of blood was unheard of, and I think curiosity had something to do with their demand. I said it was now clearly proved that he had bled internally, and that was the cause of the death. With this they were satisfied, and afterward they sat down to supper with me, but I had no appetite, for the whole business had been so ghastly, carried out too by the dim light of tallow candles, and on a body that had been buried several days. I managed, however, to keep my wrath to myself, but I hated the sight of these individuals, who came and gloated over the *post mortem*.

* * * * *

Only one mishap happened, about a fortnight later; as I was coming up from below the mill I suddenly saw a great volume of smoke, as I thought at first, but what happened was that my pipe-line had burst, and a solid column of water was being shot up some 200 ft. or more high into the air, and was falling back in great clouds of spray. The cause of this was that near the mill I had

inserted a tee-piece, with the intention of taking a branch pipe-line off it at some future date, and over the open end of the tee I had bolted a half-inch plate of cast-iron. Thinking this amply strong enough to resist the pressure, I had never calculated its strength, and it was this that had burst; but beyond a temporary shut-down no harm was done, and a new and stronger cover was soon in its place. Later in the season we had two or three days' torrential rains, and at 8 p.m. one night the mill shut-down; no water was coming down the pipe. It looked like a block at the inlet. It was raining in torrents, a pitch-dark night, and no easy job to go up the trail.

I called for volunteers from some of the night-shift men, and they were quickly forthcoming, the mine captain and myself going with them. Slowly we made our way up the hill, until we came to where the pipe-line crossed a chasm with a 22½-ft. span. The question was should we take the wide detour around it, or straddle across it? We decided on the latter. When half-way across a Mexican behind me asked if he should take my lamp, which was encumbering me in my efforts to straddle on. I recognized his voice. It was the very man whom I had always kept my eye on as the one man I was doubtful about. A push from his little finger would have unbalanced me and sent me to my death! I need not say I afterward took care to see he was helped to a better berth than the one he then had.

On arriving at the inlet it was found the pipe was blocked with branches, dead wood, and leaves. After a hard task we succeeded in clearing it, but on my return I could not quite divest myself of my suspicions of this man, and took care he was not immediately behind me again. We all got back chilled to the bone with the cold rain, and had to run a considerable risk both on the trail and in clearing away the debris, and I could only wonder what made those Mexicans volunteer to accompany us, for no extra pay had been promised them, and they asked for nothing extra. After arranging for others to take their places that night, we let them go home.

The more one sees of humanity, however debased, however bad, there is always at the bottom a good side, no matter whether barbarian, semi-civilized, or civilized; the difficulty is to get at it. The worst criminal respects the man over him who seeks to be just, and who, though outwardly hard, yet has his welfare at heart, which he knows instinctively, for it is not by talk or argument he is convinced; perhaps it is by an unconscious kind of hypnotism that passes between the two parties, or it may be that each finds some good or something to be respected in the other. So many times in my life have I momentarily been in the hands of what we could call villains, yet I have had no fear, nor even nervousness about safety. Neither was it by any egoism that I could command them, but by an inexpressible consciousness that they would respond to my demands.

* * * * *

[The following incidents relate to life in South Africa.]

I had made arrangements to take my wife and son

back to the mine, but before doing so I went up the line to visit another mine beyond the Sheba. Arriving at the nearest station to it, a Kaffir met me with a horse to ride out to the mine. It was a boiling hot day, and I had some seven to eight miles to go; the sun was glaring down on me with more than ordinarily piercing rays—at least, so I thought—and I was anxious to push on, but my beast would not. What sort of an animal it was I could not determine; it might have been a sheep in a horse's skin (for beyond a sheep's sort of gait I could not get it to go), and those seven or eight miles took me three hours to make. Meeting the manager, who was walking on crutches, I warmly asked him if my horse was purposely bought for his special benefit, as I could imagine it was only fit for a cripple.

Here I stayed to inspect the mine, located at the top of some hills overlooking the valley in the camp below. The ore from it was brought down to the mill by means of an aerial ropeway, along which the buckets traveled to and fro, but no one was permitted to travel in them; the law prohibited passenger traffic. Now, as it was a long way round to the mine, and uphill the whole way, I said I would 'inspect' the ropeway, and go up in a bucket—this would not break the law. From the receiving station at the mill I started, seated in the bottom of one of the numerous buckets which hung at regular intervals along the rope. All went well until about half-way up, when the ropeway stopped, and there I was left suspended between earth and heaven with a clean drop of about 200 ft. What had happened? They shouted up to me, but I could hear nothing that was said. In that iron bucket, with the sun's full glare on it, it was like being slowly



ANOTHER PERIL OF MINING ENGINEERING

almost the moment after starting the brute threw up its head, seized the bit firmly in his teeth, and made a clean bolt of it. I whizzed past the mill, and along the straight road leading to the station, when it took me all my effort to keep my seat. Suddenly my mount swerved off the road, making direct for the timber not far off. There was nothing left to do but to come off, for if I entered the timber it would be almost certain death. Hitherto I had been gripping my saddle tightly; relaxing my hold I did not come off, though I wanted to, and it was only by a great effort I cast myself off the brute, when I pitched on my head and saw the moon and stars. Rising in a dazed state, I found blood trickling into my eyes, and my right hand was disabled. There was no water near-by, so I retraced my steps back to the road; here I had the luck to meet a Kaffir boy leading a riding-horse going in the direction of the station. My bloody appearance frightened the little chap, and I had no difficulty in getting the horse, for the boy cleared off. The job was to mount; with considerable difficulty I did so, and rode the remaining two miles.

That evening the doctor came in, and made me plank my hand down on the table while he, with a pair of forceps and lance, picked out the dirt and cleansed out the wound. This took two hours to do, and during them I suffered excruciating torment, but he made a good job of it, though it was quite a long time before I got the use of my hand again. I had to keep it in a sling high up, for if I lowered my arm the pain was severe, otherwise I felt little of it. I learned afterward that the manager had broken his leg by that same horse having bolted with him, and it had not been ridden since until I mounted him, so my friend paid me out for my growling over the first horse he had sent to me. I also learnt that I had unwittingly caused the death of a Kaffir boy who, as I rode past the aerial ropeway, happened to be pushing off a bucket onto the rope. Seeing me, he hung too long on to it, and was carried off his perch and left suspended in the air. Unfortunately he had not the pres-



IN A BAD FIX

cooked to death in an oven. After an hour and a half thus suspended, the bucket again began to move, and in a few minutes more I was safely landed at the mine. What had happened was that the landing-man had surreptitiously gone off, having taken a holiday, and left a friend of his to take his place. This man, seeing a passenger coming up in the bucket, lost his nerve, and stopped the tramway. He then went off to find the man whose place he had taken, and I had to wait until he turned up.

ence of mind to climb into the bucket, but hung on until, letting go, he fell from a great height, and was instantly dashed to a pulp.

• • • • •

[Next we go to China.]

Taking a walk a little way up the latter river we witnessed for the first time the Chinese fishing with their cormorants. Seated on a raft anchored out in the river were one or two Chinamen, with a few brown earthenware jars, used as reservoirs in which to place the fish. Sitting beside them were the birds themselves, who, evidently at some signal from their masters, would dive into the river. The water was so clear that they were easily discernible below its surface and could be seen diving at incredible speed. Seizing a good-sized fish in its bill, up one would come and leisurely swim to the raft, where



REAL SPORT

the fisherman would take the fish out of its mouth and throw it into one of the big receptacles. Then he would dip his hand into another and pull out a small-sized fish, giving it to the bird, which would immediately swallow it. As many as six or eight cormorants were attached to each raft. Fastened round the bird's neck was a loose metal ring, which, we were told, was to prevent him from swallowing the bigger fish.

* * * * *

I had an experience at the mine which I should not like to have repeated. Down the main shaft was the ladder-way to the bottom of the mine, 300 ft. below, but instead of a series of inclined ladders there was one continuous ladder the whole way down. The inside of the shaft-timbering was lined with two-inch boards, and there was not a chink into which one could put a toe. Down this ladder I descended, but long before I got to the bottom I was tired out. Think what it was to come up! A 100-ft. vertical ladder is always a stiff climb at any time, but I had no idea of what 300 ft. meant; the heat, too, was tremendous. The first 200 ft. I surmounted comparatively well, but the last 50 ft. I shall never forget. As I got nearer and nearer the top of the shaft my strength was giving out; that last 25 ft. nearly bested me; I tried to get rid of the weight of my body by all manner of expedients; I stuck my arms right through the rungs up to the arm-pits endeavoring to get

a rest, I tried to put my knees between the rungs, but to no purpose. Another 20 ft. to climb! As I stepped off the ladder I found that all the strength had so completely gone out of my knees that I sank right down and for some minutes it was impossible for me to stand upright. Let any miner used to climbing a 100-ft. ladder try a 300-ft. one, and he will find that it is a perilously dangerous feat to accomplish. The Chinese, though, made no difficulty about it. Until I had attempted it, I had not the remotest idea of the severity of the task. Another time, by making a Chinaman take a light scantling, and by putting one end through a rung of the ladder and the other leaning against the opposite side of the shaft, I got a kind of light staging to rest on.

This shaft had been sunk and timbered as a winding-shaft; but here comes in the absurdity of the whole business: after all the cost of it and the cost, too, of boilers and engines brought all the way from America, it was decided that if erected it would bring bad luck; it was a *fenshui* business. Instead, they continued their old methods of hoisting the ore by a forest of little windlasses placed across the timbering, which reached from the surface to the bottom of the mine in the open space left along the line of the lode by the extraction of ore in the past. Each little windlass drew up from a depth of only about fifty feet, and so on all the way down. Each, again, only drew up a tiny basket of ore at a time. The lode carried a most wonderful variety of gold, silver, lead, zinc, copper, and arsenic ores. All this ore when brought to the surface by the above primitive methods was placed in large, open, paved yards where it was broken up by hand and then carefully sorted out into its different grades. From these ore-heaps it was carried in baskets by hand to the smelting establishment where, under huge red-tiled sheds, were the furnaces for smelting the lead ore, and near-by were the mills in which the gold ore was being treated. There were other mills, too, where the silver and copper ores were being treated by wet methods.

In the smelting-works Chinese methods were to be seen; a crude mixture of the East and West prevented the use of the modern reverberatory furnace in smelting the lead ore. Two modern furnaces had been built at great expense, but the man in charge knew nothing about their practical working. The very essence of the working of these furnaces is to admit air, but he had systematically shut it all off; so the galena ore was merely melted down, and no lead, as should have been the case, was produced. The reverberatory furnaces, therefore, were quite useless and unnecessary, only an additional expense.

The argentiferous lead was being refined in a German cupellation furnace, and the silver thus obtained from the lead was quite satisfactory, but this lead was smelted in a large number of rude little open-hearth furnaces and not in the reverberatories. Again, the cupriferous silver-ore, other than the argentiferous galena, was being washed with salt and treated with good results by the Russell lixiviation process, which is a most difficult process and needs a high chemical knowledge to work it;

in it the copper is finally precipitated by means of scrap-iron. But the simplest extraction, namely, that of the lead ore (the bulk of the output) in a modern furnace was a dead failure.

The whole business was a conundrum, for how was it possible for them to conduct complex processes successfully and yet fail on the more simple one? The answer I found to be in the Chinese system of control. The manager of such works must be an accountant, and consequently has no technical knowledge. The superintendent of each department is chosen by him, and if anyone is a failure he had to find it out himself; for if any superintendent was to complain of the incompetency of another one, while the latter might lose his job the former would certainly do so for going against Chinese custom. Here was a case where the head chemist knew perfectly well the reason of the failure of the reverberatory smelting, but he dared not say or he would have lost his job.

* * * * *

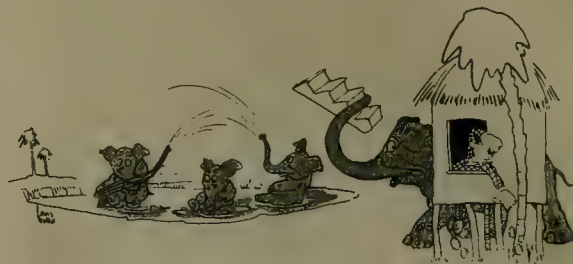
[From China we proceed to the Malay States.]

A few miles from the main camp was the logging-camp where the timber used in the mine and for construction of the mill was cut down. Some of the elephants employed in bringing in the logs to the saw-mill were brought up to the mine-camp during my visit, and every evening these used to go into a pond before sunset for their bath, and I always endeavored to get home in time to watch them. Like so many children they used to play and sport about in the water and spout water over each other. Their *mahouts* would first scrub them down with regular scrubbing-brushes, making these huge brutes lie down on their sides while they operated upon them.

On the Government post-road, two of these creatures were used to carry the mails. The smaller one was always given 20 minutes' start before the larger one was allowed to proceed. The little one usually came tearing in ahead of the other, but sometimes the bigger one would catch up with him and then give him a regular lambasting with his trunk. Another time I was coming across some paddy-fields on top of their mud-built banks, when I perceived one of these creatures coming toward me carrying on its back a whole family of Malays with all their household goods hanging down its sides and tied by bits of rope and string. Was I to go back or was the elephant? There was no room for both of us to pass, so I waited to see what was going to happen. When the elephant had nearly come up to me the *mahout* stopped it; then I saw it with one of its forefeet making a foothold with its hind foot, on which it rested, leaving me enough room to pass. I don't know at which I was the more astonished, at the intelligence of the animal in thus making way for me, or at those frail mud walls standing the weight of the great beast resting at an angle on their sides. Strangely, this was the second time I had been caught when crossing a paddy-field by an elephant, with just such a family on a removal. There is no other animal with such intelligence, and it is astonishing how they will help each other when at work.

An amusing incident at the logging-camp occurred

during my stay here. The superintendent was the only white man living there, and he lived in a comfortable bungalow with a nice staircase or pair of wooden steps leading up to his front verandah. Twice a troop of wild



SPORTIVE ELEPHANTS

elephants came down and carried off this stairway, completely destroying it. Soon afterward, when the Chinese coolies were all at work in the middle of the day, the elephants entered their lines and deliberately pulled down every house within them; but not a woman or child did they touch, though naturally both women and children were very much frightened. Nothing but pure wanton mischief! The Government officials decided to build a big stockade and entrap this troop into it. The drive was to take place a fortnight after I left the mine and I regretted very much that time did not permit me to stay and witness it. The description of how the tame elephants are used to effect this capture of the wild ones is marvelous, again proving the wonderful sagacity of these creatures. Elephants that are caught and broken in this way mostly pine and fret to death, so that the authorities seldom resort to capturing them, and only do so when they become a nuisance or a danger.

STATISTICS on the mineral production of Quebec show that in chromite, the decrease both in quantity and value has been very marked. The figures for the year 1919 are 8184 tons shipped, valued at \$223,321, as compared with 23,000 tons valued at \$770,955, a decrease of 64% in quantity and 71% in value. Nevertheless the present production is equal, in quantity, to the shipments of chromite from the mines when the industry was at its zenith under normal conditions in pre-war times. Considerable development work was effected during the year 1919. Two new concentrating mills were built, and there is every appearance that the industry has taken on a new lease of life.

THE test of concrete tanks made of 1:2:4 mixture and used for water storage, undertaken by the U. S. Bureau of Standards, has been discontinued after 150 days because the day-loss curves have taken the form of a straight line, showing that the daily loss has become constant. It may be of interest to note that these tanks, although showing some actual loss, due to water penetrating the concrete, remained dust dry on the exterior. It would seem from this that although the head of water amounted to 35 ft., the 1:2:4 concrete is sufficiently waterproof for this purpose.

Mine and Flotation-Plant of the American Graphite Company, Near Ticonderoga, New York

By C. E. CHAFFIN

INTRODUCTION. The mine and mill of the American Graphite Co. are situated at Graphite, Warren county, New York, about 12 miles south-west of Ticonderoga, which is the railroad shipping point. Graphite was first discovered in this vicinity in the early 'forties. About ten years later the American Graphite Co. was organized to develop and operate the deposits at Lead Hill, three miles from Ticonderoga; and men and machinery were brought from England to start the first graphite mine in the United States. The Joseph Dixon Crucible Co. later

cleavages. Granular graphite is also found associated with the above. This mine has not been much worked, but a considerable quantity of pure graphite is annually obtained from it, which is sold for a shilling a pound. It is thought that this is an extensive deposit."

At Graphite there are two distinct parallel beds of schist in which the graphite occurs, both dipping from 10° to 40° to the south-east. The lower bed, which alone is now being worked, consists mainly of a quartz-schist which varies from a few feet in thickness to about 30 ft.;



THE MILL

acquired control of the property and thereby centralized in a single organization the direction of all activities from mine to factory in the production of high-grade materials. After 20 years, when the operations at Lead Hill became unprofitable, the present property at Graphite was opened and has produced continuously since. There are some 25 other graphite properties in northern New York. Most of them have been operated for a time, but, so far as known, the operations have not been generally profitable and at present most of the plants are idle.

GEOLOGY. Beck* describes the Lead Hill deposit as follows: "It is a vein of the purest foliated graphite several inches wide. The foliae often have a radiated arrangement and are of considerable size. The gangue is calcareous spar, which often exhibits large and perfect

possibly 20 ft. would be a fair average. The lower bed averages 6% graphitic carbon; the flake is exceedingly thin and tough, and commands a premium price for use as a lubricant. The flake in the upper bed is small and brittle and at the present time it is not profitable to exploit it on account of the high proportion of dust produced. The upper deposit has an average thickness of approximately 12 ft. and is separated from the lower by from 20 to 40 ft. of garnet gneiss. The foot-wall of the lower bed is garnet gneiss, while the upper is capped in some places with limestone and in other places with gneiss. Above the capping the quartzite extends to the surface.

In the western part of the mine the formation is faulted and the main orebody was lost. In 1914 it was realized that the portion of the mine then developed was prac-

*'Natural History of New York', 1842, pp. 96-97.

tically worked out. When the War stopped importation of foreign graphite, the Dixon company found it necessary to increase production from its own property. T. B. Holmes, the present mine manager, after making a comprehensive study of the fault system, evolved some new ideas as to the faulting in this part of the mine, which were corroborated by diamond-drilling. It was found that the main or lower bed had been thrown almost vertically upward for a distance of approximately 100 ft. Additional drilling in this section has proved sufficient ore to maintain output at the present rate for 12 years.

MINING. Mining operations are carried on through a main haulage-tunnel that extends into the hill in a south-westerly direction for three-quarters of a mile. The maximum depth below surface is about 300 ft. Owing to the slight dip of the beds, the mine is worked in a manner similar to the room and pillar system in 'pitching seam' coal mines; the roof stands well and very little timber is required. Operations have been extended following the dip to the south-east for about $\frac{1}{4}$ mile. Since the present mining is all done below the main tunnel-level, small electric hoists are used to handle the cars on the steep grades. Electric locomotives are employed in the main haulage-tunnel and modern air-drills are used throughout.

The 'summer' open pit is east of the mine proper and has been operated only in the summer on account of the water. Recently a diamond-drill hole tapped the water, and the pit now may be operated until cold weather prevents. It is likely that the orebody exposed in the pit is an extension of the lower bed.

MILLING. The main mill building was erected more than 60 years ago, and during that time the foundation posts, below the ground level, have been renewed three times. The first machinery was designed in England and a large part of it was made there, but American-built machinery gradually replaced the foreign equipment. For a long time stamp-mills and buddles were used. In 1918 the General Engineering Co. of Salt Lake City was retained to re-fit the plant with modern concentrating machinery. The present mill started in the latter part of 1918 and has given satisfactory results for over a year. Because of the radical difference between the old machinery and the new, doubt was expressed by some as to the success of the plant, but this skepticism is rapidly disappearing in the light of the results actually obtained.

The main haulage-tracks emerge from the hill just above the mill-site and pass over a short trestle to the crude-ore bin. A No. 6 McCully gyratory crusher is placed under this bin and the ore is fed to it by hand. The product is carried on an 18-in. inclined conveyor-belt to a bucket-elevator, which in turn delivers the material to a trommel having one-inch round openings. The undersize goes direct to the fine-ore bin; the oversize passes through a set of rolls and thence to the same bin. The dry-crushing plant appears to be rather complex, but it was re-built so as to alter the scheme of the old plant as little as possible.

The ore next is fed to the ball-mill by means of a 16-in.

combined feeder and conveyor. The first grinding, to 28-mesh, is done in a 6 ft. by 22-in. Hardinge ball-mill operated in closed circuit with a standard duplex Dorr classifier. A heavy circulating load is carried in order to separate the graphite in as coarse condition as possible. The flotation-oils, fed to the ball-mill, increase the surface-tension of the pool in the classifier, thus allowing the coarse flakes to overflow the classifier, if they reach the surface, even though they may be coarser than 28-mesh. Lately it has been found advantageous to send the ball-mill product to two Deister cone-baffle classifiers and treat the spigot products of these in the Dorr. The overflow products from both classifiers combine to supply the flotation plant.

The flotation machines are standard Callow pneumatic cells arranged somewhat differently from ordinary practice. Four cells are used as roughers and make a final tailing, and a concentrate that is sent to two primary cleaner-cells. The primary tailing is returned to the rougher-cells by means of a bucket-elevator, while the concentrate at this point is screened on 100-mesh. The oversize goes to a 5 ft. by 22-in. Hardinge pebble-mill and the undersize, combining with the pebble-mill discharge, is re-floated in the first and second re-cleaner cells. The concentrate from the second re-cleaner is screened on 100-mesh; the oversize goes to a second Hardinge mill, and the undersize, combining with the pebble-mill discharge, is re-floated in the third and fourth re-cleaners. All the cleaner tailings are returned to the flotation-circuit. The final concentrate is obtained from the fourth re-cleaner and is run into settling-tanks where it drains for eight hours. These tanks have one side made of canvas in order to help the draining. From the tanks the concentrate, containing about 40% moisture, is shoveled by hand into a screw-conveyor that discharges into a revolving dryer, from which it is elevated into a storage bin. The finer sizes of concentrate as well as the purer flakes of graphite, which would otherwise go up the stack, are recovered in dust-collectors. Three grades of product result.

The sides of all the cleaners are raised about 12 in. and three wooden baffles are placed across the cells at equal intervals. The baffle nearest the discharge is level with the top of the original side; the next baffle is about three inches higher, and the third three inches higher than the second. This divides the cell into four compartments and the concentrate, in flowing from one compartment to the next, forms a small cascade over each baffle. The concentrate is taken from the end of the cells instead of from the sides, so that in the froth zone it must travel the full length of the cell (8 or 9 ft.) before being discharged. This arrangement of baffles is effective in producing a high-grade concentrate.

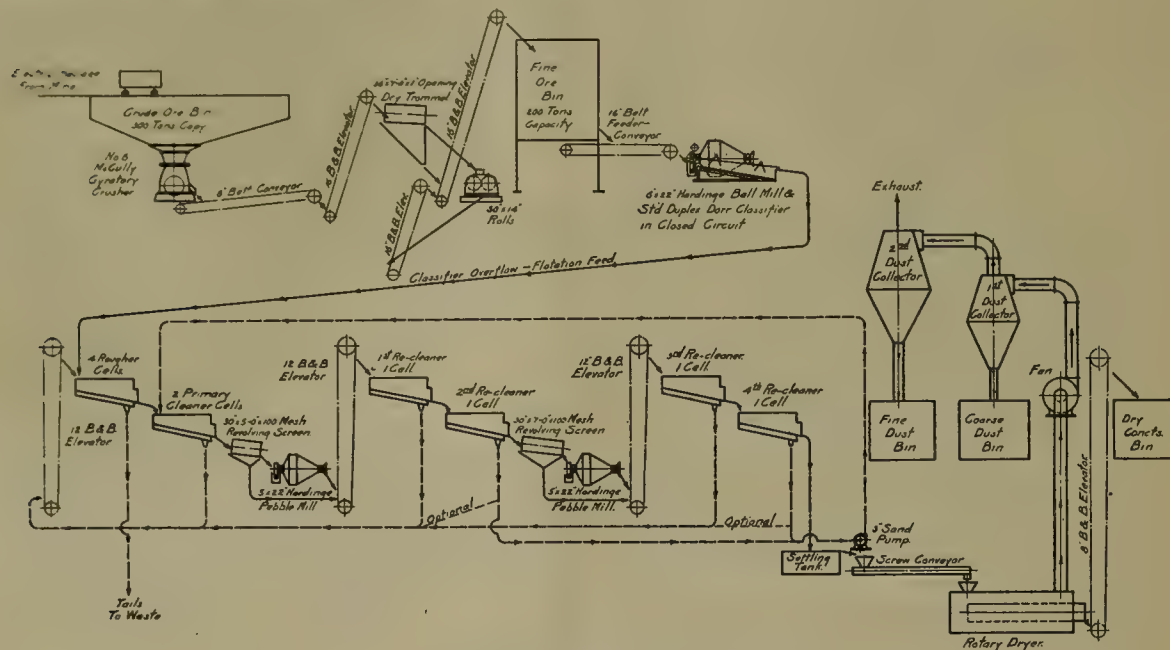
Several features somewhat out of the ordinary are found in the plant. Graphite, being a lubricant, caused some difficulty in the crushing and grinding operations; high-grade pieces of ore were particularly troublesome. Accordingly the head and concaves of the crusher are made with slight longitudinal corrugations that serve to

force the lumps of ore downward as the shaft turns. Although the feed to the 30 by 14-in. rolls had passed a one-inch screen it was found that the rolls would not nip occasional pieces of high-grade ore. Accordingly in the outside of each shell, eight sets of four 1½-in. diam. holes were drilled almost through the metal. This overcame the difficulty effectively. Similar difficulty in the ball-mill was overcome by increasing the speed of the mill. The 100-mesh revolving screens were made at the plant out of silk instead of metal cloth. Silk lasts much longer than wire in this particular service.

The mill operates 24 hours per day, six days per week, and the average actual tonnage is slightly more than 100 tons per day. The mill-heads average 5½% graphitic carbon and the total concentrate by months averages

few minutes, while the lower-grade concentrate from the dryer requires a longer period. After being ground, the material is screened in gyrating sifters similar to those used in flour mills, the coarser sizes being higher-grade. From the refinery the graphite is shipped in barrels to the Joseph Dixon crucible-plant in Jersey City, where it is used in the manufacture of a variety of products.

ONTARIO produced sundry precious metals during 1919. Platinum and palladium were recovered at Port Colborne, and also by the International Nickel Co. at its Bayonne refinery. At the latter 19,528 tons of bessemer matte was treated during the year, from which platinum, palladium, rhodium, osmium, iridium, and ruthenium was recovered. In all 1770 oz. was obtained, the



FLOW-SHEET OF THE MILL

86½%, while the coarse concentrate averages 91%. The present output of the mill is about 350,000 lb. of concentrate per month. The average actual recovery for 1919 was slightly more than 87%.

The mill and the compressors are driven by steam. A direct-current generator supplies power for the electric locomotives and for lights. Anthracite coal is used in the boiler-plant.

The dried concentrate is bagged at the concentrator and hauled to the refinery at Ticonderoga by team and truck. The three grades are kept separate, as the higher grades require less grinding. The refinery process consists simply in further grinding and screening. The grinding is done dry in cylindrical mills using small steel balls. A charge of concentrate is run into one of these mills and ground just long enough to free the graphite flakes from any small particles which may adhere to them. The concentrate from the dust-collectors at the concentrator is higher-grade and is ground for only a

estimated value being \$200,000. No definite figures are available for matte treated by the Mond Nickel Co., consequently platinum metal recovered from Coniston matte is not included. Quotations on the rarer metals are difficult to obtain. The average price of platinum for the year was \$114.61 per ounce. Palladium has been valued at \$130. Iridium is now quoted nominally at \$300 per ounce. The average value of iridium, imported into the United States in 1918, was \$114.18 and for osmium it was \$58.40 per ounce in 1918.

PLATINUM is derived from two main sources—lode deposits and placers. In the latter type the metal occurs native in the form of grains, points, pellets, and nuggets associated with gold, iridosmine, chromite, garnet, and other minerals. Lode deposits contain platinum usually in the form of sperrylite, the arsenide of platinum, although in several ores of this type the mineralogical form of the metal has not yet been determined.

Mr. MacNaughton's Advice to Students

By P. B. McDONALD

James MacNaughton, vice-president and general manager for the Calumet & Hecla Mining Co., recently delivered an address before the students of the Michigan College of Mines. Although the speaker explained that he had never given a lecture before, one could not fail to be impressed by such a speech coming from such a speaker. In order that a wider circulation be given to Mr. MacNaughton's advice to students of mining engineering, I have made the following summary of his arguments:

"There is no more upstanding, dignified, honorable, or independent profession than mining engineering. In engineering generally, you cannot evade any responsibility and you cannot blame your mistakes on anybody else. The profession is founded on the exact sciences. You have got to stand or fall, as engineers, by your individual efforts.

"The young fellow starting out in life has an idea that in order to make a competent and really first-class, high-toned engineer, he has got to start out by buying a pair of long-legged boots, and then he has got to go further and get his trouser-legs into these boots; and then he has got to get a flannel shirt and turn his collar up just as high as he can. If you appear before a prospective employer with a two or three days' growth of beard on your face and those same high-topped boots on, you are not apt to go very far; he is apt to rank you with his chauffeur; he may have a great dislike for high-topped boots, he may like low shoes; you never can tell. Beware of the high-topped boots, boys, unless you have to use them. It is not necessary to wear high-topped boots to go to the post-office."

Mr. MacNaughton then explained that a capable man recently was being considered for a position with the Calumet & Hecla, until he appeared in person. The man had half a bushel of hair on his head! "I didn't hire him. I didn't like a man with so much hair on his head; it would annoy me. I should always have been nervous with that crop of hair near."

Next Mr. MacNaughton advised the young men to get wrapped up in their respective specialties. He cited a manufacturer at Kenosha, Wisconsin (who undoubtedly buys brass made of Michigan copper), who has made a great success of making and selling beds. "That man thought in beds, he slept in beds, and he dreamed in beds. That is what has made his business a success. He was 'bugs' on beds. His ambition is to manufacture 10,000-000 beds a year; he is going to do it and he will do it. That man made a success of the bed business because he lived in beds. With him beds were the whole thing. Mr. Simmons didn't need to make beds, to make a success; he was that kind of a man, he was on his toes, he knew what he was doing."

Such illuminating little touches as this one about beds help us to interpret one successful man's opinion of

another successful man. In brief, the explanation of success is to concentrate entirely on one's specialty. If you manufacture carpet-tacks, live only for carpet-tacks; if you mine vanadium, think only of vanadium; if you catch fish for a living, dream only of fish.

A student just before graduation, said Mr. MacNaughton, imagines that "the world is standing absolutely stock still and just waiting for you; in fact, for the last three months before graduation, very little has happened in the world, it has just been waiting for you individually to get out and give it the extra push to get it going again. Every college graduate has felt the same way, myself among the number. But you will become disillusioned soon enough; the world it not waiting for you; it is going around all the time. You must realize, if you get a job, that you will be a big liability to your employer for awhile; some of you will be a liability for a longer time than others, and I have known in my experience some college graduates who were always liabilities; they never got over it; they like being a liability. Nobody wants to hire a liability, but they have to."

Mr. MacNaughton deprecated the engineering graduate's beginning life as a surveyor or chemist. Said he, "I don't think much of that, I think you ought to start in as trammers; we are short of trammers and we can give you all jobs. You can't learn too much about it; you can't begin in too humble a position."

One of the most impressive of Mr. MacNaughton's bits of advice was that about understanding men. "You need to look at the situation from the other fellow's standpoint, but bear in mind that unless you do acquire that characteristic, unless you do know men, you will not be able to handle them successfully. Cultivate that. By that I don't mean patronize them. There is an old saying, 'If you mix with the swill, the swine will eat you'."

Mr. MacNaughton concluded his address by advocating loyalty. "Don't knock him [your employer] behind his back; speak well of him. Advance his interests wherever you can; boost for him; yell for him. I cannot speak plainly enough as to the loathing with which an employer looks upon a disloyal employee. Christ said, 'No man can serve two masters'."

The students were deeply touched by the address, and felt fortunate in hearing the intimate views of a man in Mr. MacNaughton's position. Besides being an employer of many engineers, Mr. MacNaughton is a member of the Board of Control of the Michigan College of Mines.

VERMONT produces the largest quantity of talc, but the output of New York is of greater value. California ranks third in quantity and value and, notwithstanding the general decline in production elsewhere in the United States in 1918, it more than doubled its output of 1917. California produces some soapstone, but the bulk of its production is ground talc, mined in Inyo and San Bernardino counties, where it is more or less intimately associated with limestone and in part possesses a fibrous structure similar to that in much of the talc of the Gouverneur region, New York.

Mineral Production of Canada During 1919

By J. McLEISH

The War was probably the most effective agency in recent years in stimulating the development of natural resources. While it is tragic that this development should have been for the primary purpose of the destruction of life and of the long accumulated wealth of civilization, nevertheless, the result will be a rapid restoration of equilibrium and a future growth in the utilization of natural resources that will surpass all previous records. The explorations and investigations of the Canadian Department of Mines and of the Provincial Mining Bureaus have revealed some of the latent possibilities in the exploitation of Canadian mineral resources and have shown that Canada occupies an important place among the world's geographical groups as a potential source of mineral wealth.

Long before the greater production created by the War Canada had already become the world's principal source of nickel, asbestos, and cobalt, and an important producer of gold, silver, copper, lead, zinc, and a number of rare metals. Few countries possess greater resources of coal and the Canadian output of arsenic, chromite, feldspar, graphite, gypsum, mica, magnesite, pyrite, and talc, stands high in the records of world production. During the past four years under the stimulus of war demands, mineral production has increased from a total value of \$128,863,075 in 1914 to \$211,301,897 in 1918. Notwithstanding that much of the increased value indicated by this record was due to higher prices, many metals and minerals reached their highest recorded production in point of quantity during the latter year.

With the close of the War, however, came an almost immediate cessation of demand for nickel, copper, lead, zinc, and other metals, with large stocks accumulated. Mining of these metals either ceased for the time, or was greatly restricted and the year 1919 will probably be looked back upon as the transitional period between the demands of war for many products of the mine, and the ordinary requirements of industry supplemented by what we may appropriately term the demands of the period of reconstruction.

The rapidity of the change and its methods are being strongly influenced by the difficulties encountered in adjusting human relations. Production of gold, silver, and coal would have been much greater during the past year but for an actual shortage of mine-labor and the suspension of active operations for several months because of strikes. Definite records of production during 1919 will not be available for some time, but based on a broad survey of the results obtained the total value is estimated at \$167,000,000.

During the past six years the total values of mineral products have been:

	Metallic	Non-metallic	Total value
1914	\$59,386,619	\$69,476,456	\$128,863,075
1915	75,814,841	61,294,330	137,109,171
1916	106,319,365	70,882,169	177,201,534
1917	106,455,147	83,191,674	189,646,821
1918	114,549,152	96,752,745	211,301,897
1919	72,401,829	100,674,087	173,075,916

The mineral production by provinces for 1918 and 1919 was as follows:

	1918	1919
Nova Scotia	\$22,317,108	\$23,213,751
New Brunswick	2,144,017	1,675,606
Quebec	19,605,347	21,341,829
Ontario	94,694,093	65,842,826
Manitoba	3,220,424	2,846,565
Saskatchewan	1,019,781	1,118,055
Alberta	23,109,987	20,815,049
British Columbia	42,835,509	34,258,267
Yukon	2,355,631	1,963,965
Total	\$211,301,897	\$173,075,913

During the War the production of nickel was more than doubled; that of copper increased by nearly 60%; and zinc increased to five times its former output. Following the Armistice the prices of food and clothing continued to increase; the demand for such products could not abate as could the demand for metals of which accumulated stocks were for a time sufficient to meet current requirements. Silver and iron were two great exceptions for widely different reasons. However, stocks are evidently being absorbed rapidly and the rate of production is being increased as prices rise.

The value of the production of non-metallic products is largely governed by that of coal. The tonnage of coal produced in 1919 was 13,586,300 short tons, valued at \$54,051,720. The tonnage was less than that of 1918, but, on account of higher prices, the total value was only \$1,141,176 less than that of the preceding year.

Notwithstanding the progress that has been achieved in the development of Canada's mineral wealth, there are three great products—probably the most important upon which industrial activity is built—namely, coal, iron, and petroleum, for which Canada is dependent in large measure upon foreign supply. The total value of the imports of these products, much of the iron and steel in a manufactured form, and petroleum as refined oils, amounted in 1918 to \$286,115,000. Expressing the imports of petroleum as crude oil, and the iron and steel as pig-iron, the total would probably be not less than \$140,000,000. These figures indicate the great need for development of domestic resources, in order to effect the economic utilization of our Canadian coal, low-grade iron ore, and oil-shale; and they demonstrate the great necessity of intensive prospecting for higher-grade iron ores and for oil-fields.

COPPER AND NICKEL. Copper and nickel, followed by gold and silver, are the metals of first importance as producers of wealth in Canada. The nickel is derived from one main source, namely, the ores of the Sudbury

district. The other metals come from various localities, though the greater part of the silver is from the Cobalt district. The production of nickel in 1919 was 44,542,953 lb., which at 40c. per pound would be worth \$17,817,181, as compared with 92,507,293 lb., valued at \$37,002,917 in 1918. In 1914 the total production was 45,517,937 lb. About one-fourth of the production during the year has been in the form of refined metal, the refinery of the International Nickel Co. at Port Colborne having been in active operation throughout the year. The new nickel-refinery of the British America Nickel Corporation under construction at Deschenes, near Ottawa, is rapidly approaching completion and will be placed in operation early in 1920.

The price of nickel has not varied as greatly as that of other metals, either during the War, or subsequently. During 1918 the price in London varied from a maximum of £260 per long ton in May, to £195 per ton at the end of the year. In December 1919 the London price was from £215 to £220 per ton. The New York quotation varied from 45 to 40c. per pound during 1918, and in December of 1919 was 42c. per pound for ingots and 45c. for electrolytic. The production of copper during 1919 amounted to 75,124,653 lb., which at the average price in New York of 18.691c. per pound would be worth \$14,041,549, as compared with 118,769,434 lb., valued at \$29,250,536 in 1918. Even at this figure the copper production in 1919 was greater than that of 1914 or any previous year, and having in view the fact that the price fell from 26c. per pound in November 1918 to less than 15c. in March 1919, and the effect of labor difficulties in British Columbia, this record may be viewed as satisfactory.

In 1918 the production included 5,800,000 lb. from Quebec; 47,000,000 lb. from Ontario; 2,340,000 lb. from Manitoba; 62,860,000 lb. from British Columbia; and a little over 600,000 lb. from the Yukon district. In 1919 the production from Quebec, which is derived from the pyrite ores of the Eastern Townships, was 2,691,695 lb. valued at \$1,445,577, and of that of Ontario, which comes from the Sudbury nickel-copper ores, was 24,361,934 lb., valued at \$4,443,489. The Manitoba production amounted to over 3,000,000 lb., as compared with something over 2,000,000 in 1918, and was derived chiefly from the Mandy ore deposits at Schist lake, north-west of the Pas. In British Columbia the production was 44,388,934 lb., valued at \$8,296,735, as compared with 62,956,681 lb., valued at \$15,482,560 in 1918. The production from the Yukon is estimated at 334,090 lb., valued at \$62,445, as against 618,878 lb., valued at \$152,663 in 1918, which were derived from the copper ores of the White Horse district.

Development operations at Copper Mountain by the Canada Copper Corporation, which have been in progress for several years have proved the existence of 10,000,000 tons of ore with an additional tonnage probable. This ore averages 1.74% copper, in addition to gold and silver, and compares favorably with the average ore now being mined at the Hidden Creek mine at Anyox. A

2000-ton mill is about completed, a railway eight miles long, connecting mill and mine, is under construction, as is also a power-line from Bonnington Falls. Both the last undertakings have been delayed by lack of labor and strikes, but are expected to be completed toward the middle of 1920. At Rossland active mining has, on the whole, been well maintained. The copper is now being recovered in the electrolytic refinery as refined metal. The drop in price from 26c. in November 1918, to 14 to 16c. in February, with practically no market in December and January, might easily have justified a more serious lessening in activity. But as the year progressed prices stiffened and rose to 22c. in July, though they fell again to 18½c. in December.

The continued development of larger orebodies at Hidden Creek, Britannia, and Copper Mountain; improvements in the treatment of the Rossland ore; the construction of a smelter in Northern Manitoba for the reduction of the ores from the Mandy and other mines; resumption of operation at full capacity at Sudbury; and the development of numerous lesser deposits warrant the expectation of increased copper production during the present year.

GOLD AND SILVER. The total production of gold in 1919 amounted to 767,167 oz., valued at \$15,858,749, as against 699,681 oz., valued at \$14,463,689 in 1918. This output, however, is still less than that of 1916 when a total of \$19,234,967 was obtained, and far below the output during the heyday of the Yukon, when in 1900 a maximum of \$27,908,153 was produced. In 1918 the production included \$2,118,325 from the Yukon district; \$3,624,476 from British Columbia, and \$8,516,299 from Ontario, with smaller amounts from Manitoba, New Brunswick, and Nova Scotia. The Yukon district produced 90,447 oz., valued at \$1,869,705, as against 102,474 oz., valued at \$2,118,325 in 1918. British Columbia's production of gold amounted to 165,319 oz., valued at \$3,417,447, as against 180,163 oz., valued at \$3,724,300 in 1918. The principal sources of gold in this Province are the gold-copper ores of Rossland, Phoenix, Anyox, and the Surf-Inlet mine in the Skeena district; the arsenical gold-ores of the Hedley mine, and gold ores from Sheep creek near Nelson, and from Lillooet, together with some alluvial deposits. A number of very promising undertakings are being developed in the districts near the coast and much interest has been centred in the Premier mine in the Portland Canal district in which a large tonnage assaying \$30 in gold and silver has been proved.

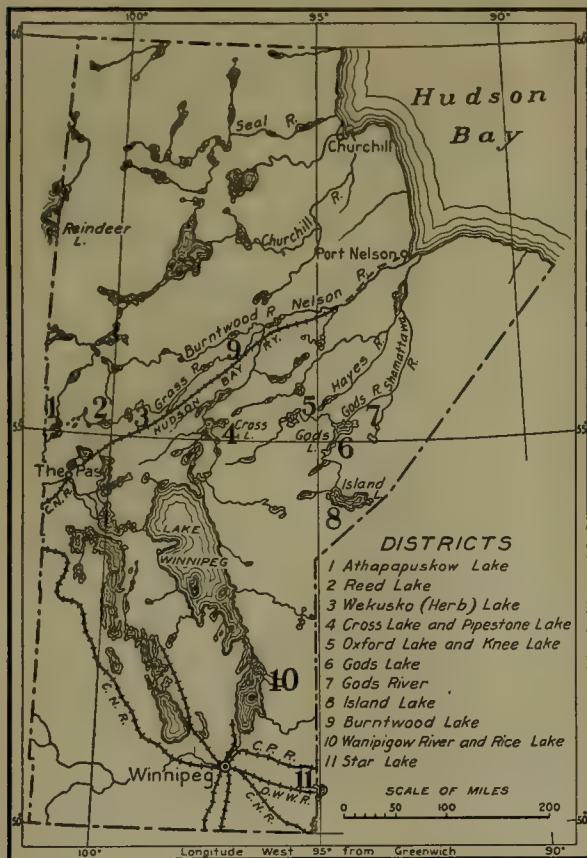
Manitoba produced 611 oz. compared with 1926 oz. in 1918 from the gold and copper ores of the Pas district, Northern Manitoba. Some spectacular finds made during the past year are attracting attention to the new districts in this Province.

Ontario's production in 1919 was 508,380 oz., valued at \$10,509,147, as compared with 411,976 oz., valued at \$8,516,299 in 1918, derived principally from the Hollinger, Dome, and McIntyre mines, with smaller contributions from the Lake Shore, Davidson, Kirkland Lake, and others. The 1919 production exceeded the record of

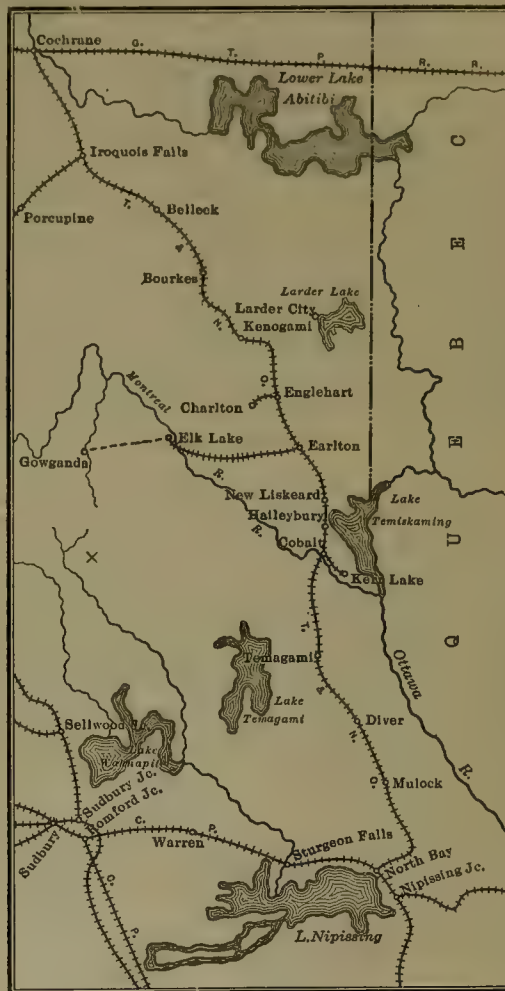
1916, which was the previous maximum. With decreasing costs of supplies and a more plentiful supply of labor greater production should be obtained. The wide extent of territory over which discoveries have been made and new gold-camps established, give excellent reason for anticipating that this Province will soon occupy a higher position among the gold-producing regions of the world.

Previous to 1908 the annual production of gold in Canada had exceeded that of silver. In 1908, with the rapidly increasing production from the new silver-producing district in Northern Ontario, the total value of silver produced exceeded that of gold and continued to

and 906,528 oz. or 5.8% was contained in blister copper. The production in Quebec amounted to 140,926 oz., as against 178,675 oz. in 1918; Ontario's production was 11,934,179 oz. or 76.1% of the total production of the Dominion. Manitoba produced 20,760 oz., as compared with 13,316 oz. in 1918. British Columbia produced 3,554,598 oz. valued at \$3,949,940, as against 3,921,336



MAP OF MANITOBA



MAP OF NORTHERN ONTARIO

remain in excess until 1914, when the growing production of the Porcupine and other Northern Ontario gold districts and decrease in the production of silver brought the value of the gold-output once more into first place. Largely because of the higher prices received for silver and the temporary restriction on gold mining because of high costs, the silver output was in excess in 1917 and 1918, also in 1919. The production of silver in 1919 is estimated at \$15,675,134 oz., valued at \$17,418,522, as compared with 21,383,979 oz., valued at \$20,693,704 in 1918.

Of the total production, 1,843,368 oz. or 75.6% was produced as bullion and refined silver; 2,925,238 oz. or 18.6% was estimated as recovered from ores exported;

oz., valued at \$3,794,755 in 1918. The Yukon produced 24,671 oz.; in 1918, 71,915 ounces.

LEAD AND ZINC. Lead and zinc are obtained chiefly from British Columbia. Ore shipments materially declined during the early months of the year. Considerable dissatisfaction was manifested by a number of shippers with the prices and purchasing conditions offered by the Trail smelter, the only lead-smelter in Western Canada. A special committee of investigation was appointed, which was given full access to the books and records of the smelting company. Evidence was also solicited from shippers. The conclusion of the committee was that the rates imposed by the smelter's lead-schedule 'B', at the time of its going into effect, were reasonable. Many

shippers of lead, however, sought markets for their ore in the United States and during the first nine months of the year lead ore was exported containing over 10,000,000 lb. of lead.

The production of lead in 1918 was 51,398,002 lb. of which 47,594,328 lb. was obtained from British Columbia and the remainder chiefly from Ontario and Quebec, with a small production from the Yukon district. Of the total, 32,782,000 lb. was recovered as bullion, the rest being lead contained in ore exported.

Production of zinc in 1918, including actual recoveries of refined zinc at the Trail refinery and estimated recoveries from ores and concentrates exported, was 35,083,175 lb. Of this amount 2,802,928 lb. was credited to Quebec province and the remainder to British Columbia.

The production of lead in 1919 is put at 43,895,888 lb., valued at \$3,057,788, as compared with 51,399,002 lb., valued at \$4,754,315 in 1918. The production of zinc during 1919 amounted to 31,738,859 lb., valued at \$2,328,998, as against 35,083,175 lb., valued at \$2,862,436 in 1918. The prices of both metals have been considerably less than during the last year of the War, that of lead having averaged about 5.73c. (New York) and of zinc 7.03c. in 1919, as compared with 7.4 and 8.16c. respectively in 1918.

The prospects for the future are, however, encouraging. The zinc plant at Trail is said to be operating on a much more efficient basis; large resources of ore are assured in the Sullivan mine and the Consolidated Mining & Smelting Co. that operates both mine and smelter, is reported to have successfully arranged for the marketing of its surplus zinc in Europe. This company probably has in its own mines sufficient developed ore to supply the full capacity of the Trail plant. Threatened competition of buyers from smelters in the United States would without doubt be welcomed by the independent mine operator of the Kootenay district.

OTHER PRODUCTS. Among other ores and mineral products for which particular demand was created by the War, and to the production of which Canada was able to contribute important quantities were: cobalt, molybdenum, arsenic, asbestos, chromite, magnesite, graphite, and pyrite. Returns from the operators are incomplete, but the exports of molybdenite were 113,520 lb., valued at \$84,228. Most of the production was derived from the Quyon, or Marsh mine near Ottawa. In the Black Lake and Richmond districts, Eastern Townships, four firms, with another to report, show the shipments of chromite to have been 8366 tons valued at \$224,971. In 1918 the shipments were 21,994 tons of ore and concentrates valued at \$867,122.

Canada's production of pyritic ores greatly increased during the War, rising from 158,566 tons in 1913, to 416,649 in 1917. The total shipments in 1919 were 177,487 tons valued at \$522,704. In 1918 the shipments were 411,616 tons valued at \$1,705,219. The production of arsenic in 1919 was 2662 tons of arsenious oxide and approximately 530 tons of arsenic in concentrates valued at \$508,770. In 1918 the production was 2482 tons of arsenious oxide and 1078 tons of arsenic in concentrates.

The shipments of graphite, which in 1917 reached the high point of 3714 tons valued at \$402,892, in 1919 fell to 1322 tons, valued at \$92,837, almost all from Ontario.

PETROLEUM. More than 90% of the production of crude petroleum in Canada is still obtained from the old oil-fields in southern Ontario, which have now been producing for 58 years. This production has been supplemented during recent years by a small annual production from New Brunswick and Alberta. The total production of crude oil from these fields in 1919 was 240,970 bbl. of 35 imperial gallons having a value of \$744,677, as compared with a total production in 1918 of 304,741 bbl. valued at \$885,143.

Accidents at Metallurgical Plants

In ore-dressing plants machinery was responsible for 40% of all fatalities and 18.17% of all injuries during 1918. Similar figures for smelting plants are much smaller for the reason that more machinery is used in ore-dressing plants than at smelters and the men are usually in closer contact with the machinery, as, for example, at jigs, tables, stamps, rolls, and crushers. There are many revolving shafts, a large number of which have projecting keys, moving belts, wheels, and cams within the reach of the operator. The machinery at smelting plants is usually confined to the power-house, where the blowers, engines, and dynamos are placed, and to overhead cranes, which are not a source of much danger to smeltermen.

At ore-dressing plants 17.14% of the fatalities were due to falls of persons, whereas at the smelters the fatalities due to falls of persons represented 9.52% of the total. Fatalities due to electricity represented 7.14% at smelters and 8.57% at ore-dressing plants. Haulage systems caused 30.96% of the fatalities at smelting plants and 14.29% at ore-dressing plants. Of the non-fatal injuries at ore-dressing plants 5.58% were due to haulage, whereas at smelters 9.58% were due to that cause. At smelting plants burns from hot metal and slag claimed 9.52% of the fatalities and 19.13% of the non-fatal injuries.

The number killed in the ore-dressing plants was 35, or 1.55 per thousand 300-day workers employed, as compared with 47 in 1917, when the fatality rate was 1.93. The total number of injuries was 3142, as compared with 2952 in 1917. In 1918 the number of men killed at smelting plants was 42, or 0.92 per thousand 300-day workers, as compared with 1.05 per 1000 in 1917. There were reported 6743 injuries, or 148.40 per 1000. Auxiliary works are intended to include machine-shops, carpenter shops, yards, and general construction, all of which, though forming part of the metallurgical plants, should not be included in the actual operating departments. The returns for 1918 show 18,044 men employed, with 17 fatalities and 2808 injuries. Reduced to the 300-day basis, this represents 20,111 workers, with a fatality rate of 0.85 and a non-fatal injury rate of 139.63 per 1000. A large proportion of non-fatal injuries was due to hand tools, falling objects, and falls of persons.—U. S. Bureau of Mines.

Formulas for Determining the Tonnage of Products From Metallurgical Operations

By A. H. HELLER

THREE-PRODUCT FORMULA FOR MILL-WORK. In many concentrating plants, especially in those working on complex ores, more than one product, besides the tailing, is made. In some plants the products are run into settling-tanks, or boxes, where a close estimation of daily tonnage may be obtained by measurement. This is true of many mills where gravity concentration only is used. In other plants, the concentrate is run into containers, such as thickeners, where it is practically impossible to measure the daily output; this is done where flotation is employed, and especially where selective flotation is in use. In operations where three products are made—for instance, two concentrates and a tailing, or one concentrate, a tailing, and a middling that may be rejected or stored for future treatment—it is often necessary to determine the daily tonnage of these products, in order to obtain a true idea of current metallurgical results. For example, if from a complex lead-zinc ore a lead concentrate and a zinc concentrate are made, and a maximum recovery of the lead is sought, even at a sacrifice of zinc, the result of one day's operations may show a high lead content in the zinc concentrate, yet the former may show the highest recovery of lead in the lead concentrate, owing to a smaller tonnage of zinc having been obtained. For this reason, it is necessary to know daily the tonnages of products. Having given the assays of mill-feed and products, and the tonnage of mill-feed, I have derived the following formula for determining the daily tonnage of concentrates and tailings; it should prove useful to many metallurgists having problems similar to those just mentioned.

The time consumed in making calculations by this method is not much more than that required to determine the tonnage of a single concentrate by the well-known formula:

Tons of concentrate =

$$\frac{\text{Tons of feed (feed assay - tailing assay)}}{\text{Concentrate assay - tailing assay}}$$

Assuming that the following are known:

Tons of mill-feed; and assay of each of two metals in (1) heading, (2) tailing, (3) 1st concentrate, and (4) 2nd concentrate.

If we let V represent one metal,

W represent another metal

$$\begin{aligned} A &= V \text{ in 2nd conc.} \times W \text{ in tailing} \\ B &= V \text{ " tailing} \times W \text{ " heading} \\ C &= V \text{ " heading} \times W \text{ " 2nd conc.} \\ D &= V \text{ " 2nd conc.} \times W \text{ " heading} \end{aligned}$$

$$\begin{aligned} E &= V \text{ in heading} \times W \text{ in tailing} \\ F &= V \text{ " tailing} \times W \text{ " 2nd conc.} \\ G &= V \text{ " tailing} \times W \text{ " 1st conc.} \\ H &= V \text{ " 1st conc.} \times W \text{ " 2nd conc.} \\ K &= V \text{ " 2nd conc.} \times W \text{ " 1st conc.} \\ L &= V \text{ " 1st conc.} \times W \text{ " tailing} \\ M &= V \text{ " 1st conc.} \times W \text{ " heading} \\ N &= V \text{ " heading} \times W \text{ " 1st conc.} \\ x &= \text{tons of 1st concentrate} \\ y &= \text{tons of 2nd concentrate} \\ z &= \text{tons of tailing} \end{aligned}$$

$$\text{Then } x = \frac{(A + B + C - D - E - F)}{Y} \times \text{tons of heading}$$

$$\text{where } Y = A + G + H - K - L - F$$

$$\text{and } y = \frac{E + G + M - N - B - L}{Y} \times \text{tons of heading}$$

$$z = \frac{D + N + H - K - C - M}{Y} \times \text{tons of heading}$$

If we have the assays of each of three metals in the heading, concentrates, and tailing, a double check is available. For instance, if on a copper-iron-zinc ore, a zinc concentrate and a copper concentrate are made, and the assay of copper, iron, and zinc be known for the heading and for all the products, the tonnages may first be determined by using assays for copper and zinc, checking them by using those for copper and iron, and re-checking these by using the assays for iron and zinc. If a close check is not obtained, it is due to errors in sampling or assaying.

I have derived the above formula in the following manner:

Let tonnage to mill = 1

$$\begin{aligned} x &= \text{tons 1st concentrate} \\ y &= \text{tons 2nd concentrate} \\ z &= \text{tailing in tons} \\ V &= \text{one metal} \end{aligned}$$

W = another metal

$$\begin{aligned} a &= \text{assay of V metal in heading} \\ b &= \text{ " " " " " 1st concentrate} \\ c &= \text{ " " " " " 2nd concentrate} \\ d &= \text{ " " " " " tailing} \\ e &= \text{ " " W " " heading} \\ f &= \text{ " " " " " 1st concentrate} \\ g &= \text{ " " " " " 2nd concentrate} \\ h &= \text{ " " " " " tailing} \end{aligned}$$

$$\text{Then: } x + y + z = 1$$

$$bx + cy + dz = a$$

$$fx + gy + hz = c$$

Solving the above equation of three unknowns, we have:

$$x = \frac{ch + de + ag - ce - ah - dg}{ch + df + bg - cf - bh - dg}$$

$$y = \frac{ah + df + bc - af - de - bh}{ch + df + bg - cf - bh - dg}$$

$$z = \frac{ce + af + bh - cf - ag - bc}{ch + df + bg - cf - bh - dg}$$

As the above formula is worked out for one ton of mill-feed, the tonnage of the products may be obtained by multiplying the values of x, y, and z by the number of tons milled.

As there is a duplication of multiplication in the above, for simplicity, I have let

A = ch	E = ah	K = cf
B = de	F = dg	L = bh
C = ag	G = df	M = be
D = ce	H = bg	N = af

in the equations for x, y, and z in the derived formula.

CALCULATIONS FOR DETERMINING THE TONNAGE OF PRODUCTS FROM SMELTING OPERATIONS. In practically all smelting operations there are four products, namely, a matte or other metallic product, flue-dust, slag, and a gaseous product. The formula for determining the tonnage of these is longer than that given for three-product mill-work. However, in smelting it is not possible to obtain a daily estimate of the tonnage of the products, owing to the length of time that the material remains in course of treatment. The effects of a change in the charge on a furnace may not become apparent for a day, whereas in mill-concentration a change in the character of feed will be noticeable within a few minutes. For this reason it is advisable to determine the tonnage of products from smelting only at intervals of from 15 to 30 days.

At most smelters the quantity of matte, or metallic product tapped, is determined accurately by direct weighing, but it may not represent the actual amount of matte made, since, owing to a change in the grade of ore, or a change in the matte-level in the furnace, the quantity tapped may not represent that actually formed in the furnace. A fairly accurate weight of the slag can be determined when slag is skimmed into cars of known capacity, but if the slag is granulated or skimmed directly into dams, any estimation would be inaccurate. Few plants are able to estimate directly the amount of flue-dust produced. The plants that have efficient systems for catching dust are few, and those that have, probably do not estimate the tonnage of flue-dust or fume per lot of charge. The tonnage of gaseous product can only be obtained by calculation.

To determine the tonnage of the four products mentioned above, the weight of charge to the furnace must be known, together with reliable composite assays of charge, matte or metallic product, slag, and flue-dust or fume. There are various ways of obtaining a fairly good sample of the flue-dust or fume leaving the furnace; these are known to every smelter-man.

The assays of three metals, besides sulphur, in the charge and products must be known. The following has

been my method of determining the products obtained, and I have always found that my calculated matte checked my actual production within reasonable limits.

Let tons charged to furnace = 1

b = assay of 1st metal in matte
c = " " " " " slag
d = " " " " " flue-dust
f = " " 2nd " " " matte
g = " " " " " slag
h = " " " " " flue-dust
j = " " 3rd " " " matte
k = " " " " " slag
l = " " " " " flue-dust
m = " " 1st " " " charge
n = " " 2nd " " " charge
o = " " 3rd " " " charge
x = tons matte
y = " slag
z = " flue-dust

$$\text{Then: } bx + cy + dz = m$$

$$fx + gy + hz = n$$

$$jx + ky + lz = o$$

Solving the above equation of three unknowns, we have:

$$x = \frac{mgl + cho + dnk - dgo - cnl - mnh}{bgl + chj + dfk - dgj - cfl - bhk}$$

$$y = \frac{bnl + mhj + dfo - dnj - mfl - bho}{bgl + chj + dfk - dgj - cfl - bhk}$$

$$z = \frac{bgo + cnj + mfk - mgj - cfo - bnk}{bgl + chj + dfk - dgj - cfl - bhk}$$

As before the values of x, y, and z must be multiplied by the number of tons charged to the furnace.

Having obtained the tonnage of products according to the above formulas, and knowing the sulphur analysis of charge and products, the difference between the sulphur content (in pounds) of charge, and the total of the sulphur contents of the products, would be the amount driven off as gas. This sulphur is exclusive of any sulphur in the form of SO_3 , which has combined with any oxide to form solid sulphate, the latter being included in the sample of flue-dust or fume and consequently in the tonnage of flue-dust, or fume.

CONTINUOUS breathing of the very fine sharp particles of quartz that constitute the dust in many metal mines produces a mechanical injury to the lungs, causing a disease peculiar to the mining industry, and known as miners' consumption, miners' phthisis, miners' asthma, silicosis, or more accurately pneumoconiosis due to silicious rock dust. A man engaged underground should carefully avoid working in the dust.

IT IS REPORTED that the Italian government is arranging to purchase the large Abruzzi and Tannium bauxite deposits, to be worked by the Government. The probable intention is to manufacture aluminum wire to be used in place of copper in the electrification of the Italian railways. Italy's resources of bauxite are sufficiently extensive to permit production on a large scale.—U. S. Bureau of Mines.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

MILL AT DUNCAN IS COMPLETED.

BISBEE.—The sinking of the Nighthawk shaft from the 650 to the 750-ft. level was completed last week. A station has been cut on the 750-ft. level and preparations are being made to drift and prove the orebodies developed on the upper levels. It is reported that 40 ft. of oxide ore averaging 6½% copper was cut on the 550-ft. level. Two cars of this ore have been shipped. The Shattuck Mining Co. has commenced sinking the shaft from the 900-ft. level to the 1100-ft. level. A 3000-ft. Nordberg compressor is being installed at the Denn property and it is expected to be in operation by the end of April. Drifting on the 1800-ft. level has been commenced. It is reported that the Calumet & Arizona Copper Co. is to explore thoroughly by drilling the limestone below the 1500-ft. level of the Briggs mine, which is estimated to be 1000 ft. thick.

DUNCAN.—The \$150,000 mill of the Duncan Mining & Milling Co. at Mount Royal 10 miles from Duncan has been completed. It is announced that this mill is of sufficient capacity to handle custom ores in addition to those mined by the company.

JEROME.—Shipments at the rate of five tons of copper ore per day are now being made by truck from the Franco-American mine to the Humboldt smelter. This ore is said to assay 40% copper and 17 oz. silver. The Jerome Prescott Mining Co., which has taken over the old Sanders group of 32 claims, has started development work upon one claim in which there are excellent prospects of gold. The present inclined shaft is to be deepened.

KINGMAN.—It is reported that French capital is financing the Middle Hackberry Co., \$50,000 having been raised to develop the mine. Development work is to be commenced immediately.

A company to take over the Pay Roll mine at Chloride has been organized.

The Arizona Buttes Mines Co. was formally taken over by the Kingman Consolidated Mines Co. on April 1. A new boarding house and two bunk-houses are under construction at the camp near the tunnel. A larger compressor is to replace the old one, which will be moved to the Banner mine.

The Hackberry Consolidated Mining Co. and the Senate Silver Mining Co. have been consolidated. Work has been discontinued on the Senate Silver property and

the development from the Hackberry Consolidated shaft which has been planned is now under way.

PARKER.—The Mammon Copper property, 10 miles east of Parker, is to be drilled. Copper ore, assaying as much as 10%, has been developed in a 13-ft. vein. The vein is at present opened by a 178-ft. shaft and 2000 ft. of tunneling. The work will be done under the direction of W. M. Boyce, while E. W. Brooks and Walter H. Weed are consulting engineers.

TOMBSTONE.—A Colorado company has taken a bond and lease on the Cummings-Wolcott-Cowan properties in the Courtland district. Machinery is being repaired preparatory to unwatering the mine.

COLORADO

OPERATORS AT CRIPPLE CREEK AWAIT ACTION ON PROPOSED EXCISE LAW.

CRIPPLE CREEK.—Gold-mine operators in the district, anticipating enactment by Congress of the law providing an excise tax on jewelry and manufactured gold, are



OLD DOMINION PLANTS AT GLOBE, ARIZONA

playing a waiting game. Production has been reduced to a payroll basis, and except for the corporations with a cash reserve, development is at a stand-still. April, being the first month of the second quarter, is usually a dividend month, but to date, excepting for the regular monthly dividend of the Golden Cycle company of 10 cents per share, payable on April 10, and the reduction from 2 to 1½ cents, or from \$60,000 to \$45,000 by the Portland company, no other dividends have been declared. Miners are leaving the district as rapidly as possible, and it is generally believed another exodus will

occur following the settlements of accounts if the April pay-checks will supply railway fare. Conditions confronting the gold industry here need no further comment and unless Congress acts promptly, production will apparently continue to decrease.

T. R. Countryman, consulting engineer to the War Eagle Consolidated Mines Co., in reporting connection made on April 2 from the Blue Flag workings with the Moffat tunnel, stated that the "ventilation was thorough". The entire tunnel and Blue Flag workings are completely ventilated with pure, fresh, cool air. The draft is so strong that a carbide-lamp cannot be kept alight in the drift. The engineer further reports a streak of black sulphide in the east wall, more than six inches thick assaying \$25 in gold, with a width next to it of one foot assaying \$19.40. This is in addition to 20 in. of ore opened in the drift.

The Blue Flag Gold Mining Co., now that the contract for connection with the Moffat tunnel is completed, will continue development of its Raven Hill properties lying north-west of the Cresson mine. Carpenters are at work framing mine-timbers and the head-frame is to be raised. New cables have been delivered and the skip and other equipment are on the way from Denver. The bottom level of the Blue Flag is now 1417 ft. deep, with elevation at the collar of the shaft 9019 ft. On the 12th level, east, a good formation has been entered, with some gold content. In the south drift the ore is of milling grade, with conditions improving with each round. Cross-cutting and drifting is to be continued at both the 12th and 14th levels until orebodies known to exist east and west of the main shaft are cut.

LEADVILLE.—Exclusive of the Down Town mines, the Ibex and Yak tunnel property, more than 50 mines are again under active development, on company account or by lessees. Production necessarily is materially increased. The samplers report more ore coming in, while the fourth furnace of the smelter is now in operation.

Among the properties to resume soon are the Rattling Jack, adjoining the famous Little Jonny, and the Hartford, O'Donovan, Rossa, and Peoria Boy, under lease to the Leadville Leasing Co. The Continental Chief is to be electrically equipped and will be in shape to operate by the end of the month. The National Development company of Chicago is making preparations to start work on the Big Chicago, Ready Cash, Cora May, and the Auroras 1 and 2, in the vicinity of Big Evans gulch. Five claims near Kevin mountain, owned by W. G. Parker, have been secured under bond and lease by the National Development Co., and work will start in earnest with the disappearance of snow.

MICHIGAN

WOLVERINE TO DEVELOP NEW PROPERTY.

CALUMET.—The adoption of a policy of extension on the part of the Wolverine corporation has excited interest in Calumet. Six years ago the proposition was made to the Wolverine corporation but the management at

that time did not look with favor upon any scheme calling for the purchase of additional territory, taking the stand that the business of the company was to mine out such territory as it owned and then to quit. A tract of 480 acres, owned by the St. Mary's Mineral Land Co., the Douglass-Shelden interests, and the Union Land company is involved. The problem of mining could be worked out along the lines of the re-hoisting scheme which the Calumet & Hecla now has in successful operation handling the 'five forties' from the bottom of the Red Jacket shaft, and which will be followed out in the further development of the Calumet conglomerate lode from the 81st level. There would be less than half a mile of dead territory to go through, although the shaft would have to be put through some South Kearsarge territory. This belongs to the Osceola Consolidated company, but it is believed that there would be no difficulty in making satisfactory arrangements with that company. If not, the shaft might be sunk through the foot-wall of the lode. The fact that engineers of the two mining companies, Osceola and Wolverine, are conferring is considered significant. Wolverine shareholders are heartily in favor of any scheme which gives promise of prolonging the life of the company.

HOUGHTON.—Practically every mine in the Michigan copper district got out a larger production in March than in February. Yet the figures do not show any material increase in the output of refined copper and the total of the district continues at 60% of normal and less than 50% of the possible output provided there were sufficient labor. Osceola produced 50,000 tons in March, compared with 49,000 in February. Of this amount 12,000 came from the old Osceola mine and 38,000 from the Kearsarge branch.

Ahmeek produced 68,000 tons during the month, a little less than in February. The Ahmeek was one of the few mines that showed a good output in February. Centennial produced 7000 tons in March as against 6525 tons in February and 7500 in January.

Allouez showed a substantial betterment in March increasing from 14,231 tons in February to 20,500 tons in March. Isle Royale kept her own three-head stamp-mill running full time in March and sent 2880 tons to the custom mill in addition. Superior got out five cars and La Salle ten cars, all in the course of development operations which are continuing at these properties with practically nothing new revealed.

MONTANA

DEVELOPMENT OF THE EDITH MAY VEIN IN THE NORTH BUTTE MINE.

BUTTE.—The North Butte Mining Co. has picked up the heavily mineralized section of the Edith May vein on the 3200-ft. level. Drifting for a distance of 50 ft. east opened a width of 15 ft. of ore averaging 6.2% copper and 3.5 oz. silver per ton. Easterly, on the level above, ore averaging 1½ ft. wide with an assay value of 21% copper and 4.5 oz. silver has been opened. To the west

on this same level 32 ft. of drifting was in ore of an average width of 2½ ft. assaying 7% copper and 3.5 oz. silver. Operations are being concentrated on the 3400-ft. level in an endeavor to pick up the high-grade ore developed on the 3200-ft. level in the Edith May vein.

Production at the Butte & Superior for March from 43,000 tons of ore milled amounted to 10,500 tons of zinc concentrate and 150 tons of lead concentrate. The zinc recovery was 11,150,000 lb. while the total silver in the ore was 210,000 ounces.

The Clark interests, operating the Timber Butte mill and the Elm Orlu mine, have contracted for \$1,500,000 of insurance on the lives of 1500 employees. The premiums are to be paid by W. A. Clark himself. The

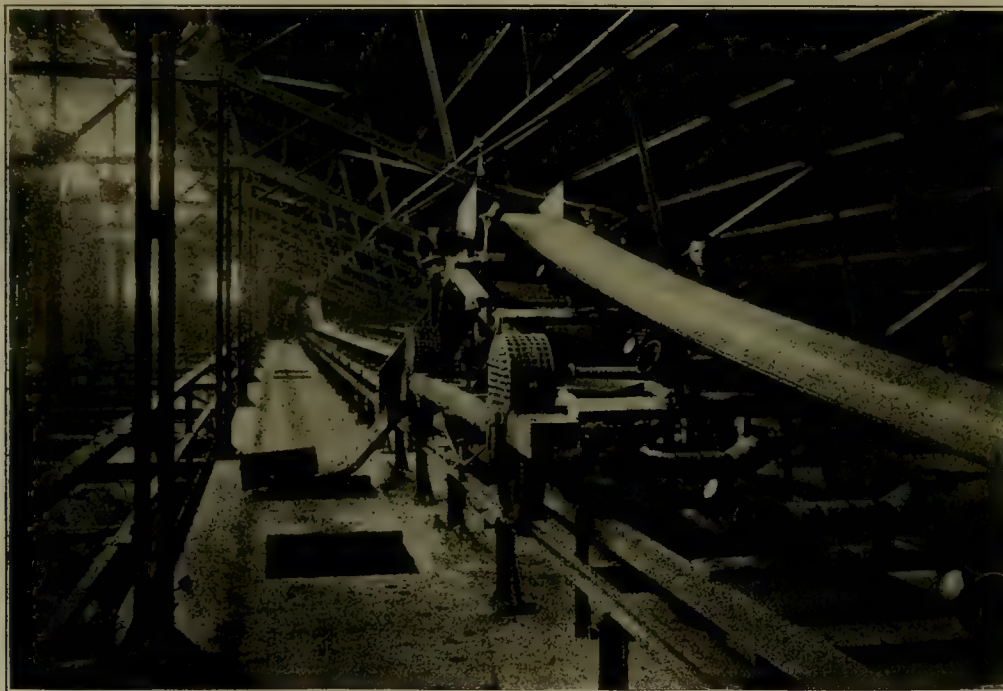
A high-grade optical glass will be made from the mineral.

NEIHART.—Production records are being established by many of the mines here. A New York syndicate has taken over the Florence mine from E. A. Shaw and Allen Pierce of Great Falls. The Neihart Consolidated Silver Mining Co. is now a steady shipper with its Hartley mine as the leading producer. Electrical equipment has been installed at the Broadwater mine and sinking of the shaft commenced.

NEVADA

RICH ORE AT MONTEZUMA SILVER MINES.

MONTEZUMA.—At the present depth of 296 ft. the shaft of the Montezuma Silver Mines Corporation has been in



CONVEYOR AND TRIPPER. ANACONDA COPPER COMPANY'S LEACHING PLANT AT ANACONDA

amount of insurance ranges from \$500 to \$2500 depending on the length of service.

The February production of the Barnes-King Development Co. was as follows: from the North Moceasin mine, 1799 tons, yielding \$7.63 per ton; the Gloster mine, 1225 tons, yielding \$9.10 per ton; and the Shannon mine, 2209 tons, yielding \$8.42 per ton; making the total production 14,377 tons.

The Butte & Plutus Mining Co. has increased its capitalization to \$1,000,000. The company's Mapleton shaft is being sunk to the 250-ft. level from which the main Norwich-Mapleton vein will be cut. Continued sinking to the 400-ft. point is planned so as to cut the rich Norwich vein at that level. This vein is 12 ft. wide in the upper workings with excellent silver content.

SPRINGDALE.—The Pittsfield Mining Co. of Billings is preparing to exploit a large deposit of crystallized calcite.

ore continuously for 45 ft. and general conditions are the same as when the find was made at 251 ft. The lowest assay secured from the entire bottom of the shaft has been \$50 and at 296 ft. the rich seam has reached the maximum width of 40 in. An assay of \$212 in silver and lead was secured from this 40-in. width. The copper and zinc content is good. The average width of the vein as exposed in the shaft is from 4½ to 5 ft., but blasts into the irregular foot-wall have opened high-grade ore and when the 300-ft. point is reached a cross-cut will be driven into this wall. Drifts will be driven at 200 and 250 ft. when compressors now at Goldfield reach the mine. Drifts to be driven at 300 ft. will be the first in the ore-shoot. Only a few years ago the claims of the Montezuma Silver were sold for taxes and the company paid \$2000 to redeem them. For years Arthur Cooper, superintendent, fought a remarkable battle to continue work on the claims, as

there have been few times when the company was not in financial straits or other difficulty. In part payment for his work he has taken 25,000 shares of stock in the company and miners employed shortly before the find was made were paid partly in stock, which has become valuable.

TULE CANYON.—Fourteen men are employed by the holders of the option on the Ingalls. These men formerly were employed at the Gibraltar, where work has been stopped. The Gibraltar and the Ingalls are controlled by the same interests.

QUARTZ MOUNTAIN.—Eastern interests are negotiating to take over the Edwards group, on which the holders of a 5-year bond and lease recently opened on the surface what is reported to be a promising vein of gold ore.

GOLDFIELD.—A promising body of rich ore has been opened in the Cracker Jack lease on the Florence and it is expected that within 10 days the management will make a statement of conditions. The ore is being blocked out and it is reported that a considerable tonnage has been broken. The tunnel being driven by the Five to One far south of the Florence is over 350 ft. long and for the last 125 ft. it has been in talc containing seams of quartz from which good pannings are obtained. It is thought the vein will be cut within 50 ft. The Florence company has connected the west cross-cut on the seventh level with the old Moore lease shaft, which so improved the air in the cross-cut that drifting can be started.

ARROWHEAD.—At 45 ft. from the shaft the west drift on the 100-ft. level of the Arrowhead for 35 ft. has been in ore assaying \$125 over a width of 3 ft. The vein is 5 ft. wide. A raise is being driven from the west drift on the 165-ft., or bottom level, and when this has been completed sinking of the shaft will be resumed and continued to the 300-ft. point. The ore-shoot east of the shaft has been opened for a length of 65 ft. and a raise between the bottom and the 100-ft. level is in ore of high shipping grade.

UTAH

SALT LAKE CITY AS A SMELTING CENTRE

SALT LAKE CITY.—Salt Lake City took first rank as an ore-smelting centre during 1919, according to a compilation showing the tonnages treated by the smelting plants of North America, prepared by H. M. Adkinson. Taking into consideration both copper and lead-silver capacities for 1919, the Salt Lake district totaled 4,430,000 tons, of which 1,830,000 tons represents lead-silver and 2,600,000 tons copper furnaces. The furnace capacity at Douglas, Arizona, the nearest rival, was reported as 3,970,000 tons, while Anaconda's capacity was 3,580,000 tons. All four of the smelters in this vicinity are in operation; the silver-lead plants being the Murray and Midvale smelters, the exclusively copper smelter being the A. S. & R. plant at Garfield, while the Tooele smelter of the International Smelting & Refining Co. handles both copper and lead-silver ores.

BINGHAM.—On April 6, all the mining companies

posted notices, announcing that wages would be increased 25c. per shift, effective April 1. Since last July, the wages paid here to underground employees have been 25c. per shift less than those paid to similar employees in the other camps of this State. This increase, therefore, puts all wages paid in Utah mines on the same base scale. Under the new scale, machine men and timbermen will receive \$5.25 per day; miners, \$5; muckers, \$4.75; and mine laborers, \$4. On the following day, the various smelters and milling plants in Salt Lake valley posted notices announcing a similar increase.

ALTA.—An unfortunate accident occurred here on the morning of April 5, when a large snowslide swept down from the property of the Sells Mining Co., and carried everything before it on the property of the Wasatch Mines Co. One miner, the steward at the auxiliary plant of the Wasatch company, and his wife were killed. For years it has been the belief of the Wasatch mine officials that the buildings at the auxiliary plant were absolutely safe from slides. They were situated on a knoll and from one direction they were protected by a gulch and then by a large clump of trees. The rushing mass, with a roar heard for miles, crossed this gulch and swept up the incline, tearing immense trees from their roots and reducing the boarding and bunk-house to kindling. It then switched its course and passed directly between several other buildings, including the compressor-house, transformer-station, powder-house, and machine and blacksmith-shop, which were not damaged. This is the third snowslide to occur in this district within 30 days; the first having been on March 7, near Lake Solitude, and the second on March 20 near the Peruvian mine. In these two slides four men were killed, making seven lives that have been lost in the three slides.

PARK CITY.—Another shipment of 'premium' spelter was made by the Judge Mining & Smelting Co. during the week ending April 3. Ore shipments for the same period totaled 2095 tons, as compared with 2206 tons for the previous week. The Ontario Silver shipped 616 tons; Silver King Coalition, 605; Judge M. & S., 440; Daly-West, 233; Daly, 108; and Naildriver, 60 tons.

As an inducement to steady work, the Judge company is now paying a bonus to men working thirteen consecutive days. Every employee who puts in thirteen days is paid for fourteen days work. It is likely that other companies here will adopt a similar plan, as the present scarcity of good miners is a great drawback. The new pump at the Iowa Copper has been placed and was started on April 4. It is being used to unwater the shaft and drift, and within a short time, work in the face of the drift will be resumed. This property is now equipped for extensive work. Owing to the deep snows, eleven days time was required to get the new pumping equipment from the station to the mine, the snow being six feet deep in places.

J. B. Allen, manager of the Glenallen property, reports that a new orebody was struck on March 31. Sufficient work has not been done to determine the size of the vein, but samples so far taken indicate first-class ore.

EUREKA.—Ore shipments from the Tintic district for the week ending April 3 totaled 151 cars, a decrease of 13 from the previous week. Inclement weather and bad roads were, in part, responsible for this decrease. Influenza at Mammoth, a section of the camp which has been immune to past epidemics, seriously checked operations at several of the adjacent mines. The Chief Consolidated shipped 39 cars; Tintic Standard, 20; Dragon Con., 20; Eagle & Blue Bell, 11; Iron Blossom, 10; Centennial-Eureka, 8; Gemini, 7; Mammoth, 6; Grand Central, 6; Victoria, 6; Colorado, 5; Bullion Beck, 3; Empire Mines, 3; May Day, 2; Ridge & Valley, 2; Swansea, 2; Alaska, 1.

During the past week, prominent mining operators of

tem would be more efficient in affording effectual action in case of emergency.

The shaft at the North Beck Mining Co.'s property has reached a depth of 1620 ft. Sinking has been discontinued, and miners are now cutting a large station on the 1600-ft. level, which is the point selected by E. J. Raddatz, manager, for prospecting. This company owns a large tract of ground which is just north of the town proper. Mr. Raddatz is also developing the Victoria Gold Mining Co. property, adjoining the North Beck, and the main inclined shaft, which was sunk to a depth of 500 ft. a few years ago, is being deepened.

During 1919, but little progress was made at the Colorado Consolidated mine, which in by-gone days was the



THE TINTIC STANDARD MINE, IN THE EAST TINTIC DISTRICT, UTAH

this district met with members of the Eureka volunteer fire department, and a plan was formulated whereby the firemen, many of whom are miners, will take special training in mine-rescue work. The mining companies will supply the equipment and will pay a competent man to train those selected to take the lead, paying the firemen for the time they spend in training and in carrying out rescue work. The fire-department apparatus will probably be used in case of serious mine accidents and, in this manner, the trained men could be sent to almost any mine in the district within a few minutes' time. Only the mines of Eureka, Mammoth, and Silver City will be interested in the proposition which has been submitted to the department, such properties as the Tintic Standard and others in the eastern part of the district being too far away from Eureka to participate in such an arrangement. The Tintic Standard will likely secure its own equipment and keep a number of men properly trained. Heretofore each mine has had its own 'safety-first' department, but the operators feel that a co-operative sys-

tem would be more efficient in affording effectual action in case of emergency. The value of the ore shipped was \$107,435. According to the annual report, the revenue of the company was spent on exploration work which did not give satisfactory results, and such work was discontinued at the close of the year. The development work done during 1919 was undertaken primarily for the purpose of determining geological conditions, which it was hoped would be of value in further search for new orebodies. The mine is now being worked under the leasing system, cleaning up old stopes.

WISCONSIN

REVIEW FOR MARCH.

PLATTEVILLE.—March carried much of disappointment in it for zinc-operators. Weather adversely suited to output, an acute scarcity of labor, and unsatisfactory offerings for ore featured the month. The spring break-up was long deferred and roads were so wretched in some districts that shipments were discontinued. The result is a large accumulation of unsold milled ore, which may in

the end prove a benefit to sellers, should a higher market develop. An acute scarcity of shovelers found owners and managers seeking other expédients, and this drawback toward more production will before very long have been obviated to a large extent. Negroes have been imported into the district for work as muckers and trammers and two of the larger operating concerns have purchased mechanical shovels for which strong claims are made on the ground of efficiency. One machine, the invention of a miner, will load, with one man in control, a 3-ton car in three minutes. It is made to work by compressed air, in drifts of any dimension that will carry the machine. The satisfactory use of this machine at three mines in the field will no doubt encourage a general demand. The chief drawback to a higher output, however, is found in the offerings submitted by purchasers for all grades of zinc ore. The base price for high-grade zinc ore the first week in the month was nominal at \$52 to \$54 per ton, according to the prices paid for high-grade blende under contract sales. This price held until the third week when the base was approximately \$52 per ton. The Mineral Point Zinc Co., through its purchasing department, upset rules by bidding up one lot of prime Western ore, about 250 tons, to \$60 per ton. This concern, regarded as one of the largest smelter organizations in the country, is largely engaged in the business of mining zinc ore as well, and the action taken in covering on a lot of high-grade ore, in open market, set operators to pondering whether or not they were receiving enough for their ore.

The lead-ore market was good but no disposition to sell freely was manifest although production was far from what might be expected under the circumstances. That a considerable tonnage of milled ore is held in bins, at various places in the field, is fairly well known. The price which held at better than \$100 per ton, 80% metal content, reached \$105 the middle of the month, and later was advanced to \$107.50 per ton in the Mo-Kan-Okla districts. It was intimated that better than this had been paid for milled lead, considered high-grade, and in one instance a seller stated that a small car had been sold at \$115 per ton. No definite price could be learned from local sources and standard publications were compelled to accept figures given out through metal exchanges. Shipments for March were extremely light when compared with reports for the preceding months of this year. Restricted milling is responsible for a lowered production, as the bulk of lead ore obtained at mills is contingent on the tonnage of mill-diet handled and fluctuates according to the volume of ore treated in wet mills. Prospecting for lead ore has been stimulated on account of the high prices, but no noteworthy discoveries have been reported.

Shipments of pyrite from separating-plants have been nil. The purchase of the Federal plant at Cuba City, adjoining the National Zinc Ore Separating Works, for the manufacture of poison gas, of a most deadly type, by the Vinegar Hill Zinc Co., affiliated with the National Separators, heralds the establishment of an important

branch of the mining industry in this field, as the plant is being made ready with a large force of carpenters, pipe-fitters, and general construction men for the making of sulphuric acid. The residue obtained at separating-plants can be utilized to good advantage in this industry and heavier deliveries of low-grade pyritic ores may be expected shortly as it is the purpose of those in control to be shipping acid by the first of next June. The gases now wasted at the National Separators in the roasting of low-grade zinc ore, or pyritic ores, will be conserved and converted into sulphuric acid.

Very little improvement was shown during March, in the output or marketing of carbonate-zinc ore, in the northern districts of the field. Some production was made at the mines of the New Jersey Zinc Co., and several new prospects have been fitted up for production, inviting a larger output during the open season in this region.

Deliveries of ore by districts, from mines to separating-plants, and direct to smelters were made for March as shown:

District	Zinc, lb.	Lead, lb.	Pyrite, lb.
Benton	9,800,000	506,000	.....
Livingston	4,440,000	.....	2,806,000
Galena	2,868,000	121,000	.....
Hazel Green	734,000	.....	.....
Highland	720,000	.....	.....
Linden	612,000	50,000	.....
Cuba City	166,000	.....	206,000
Total	19,340,000	677,000	206,000

Shipments of the high-grade separator-blende, from reduction works in the field to smelters, were made as follows:

Company	Lb.
Mineral Point Zinc Co.....	5,304,000
Wisconsin Zinc Co.....	2,806,000
National Zinc Ore Separators Co.....	2,504,000
Zinc Concentrating Co. (Cuba City)	462,000
Total	11,076,000

The gross recovery of raw ore at mills amounted to 9670 tons; net deliveries to smelters amounted to 5928 tons of blende and 360 tons of carbonate-zinc ore. On distribution the Mineral Point Zinc Co. received 3982 tons; Wisconsin Zinc Co., 2637 tons; National Separators, 2351 tons; Linden Concentrating Co., 360 tons. On high-grade to smelters, Mineral Point Zinc Co., 2652 tons; American Zinc Co., 1403 tons; United Zinc Smelters Corp., 914 tons; Grasselli Chemical Co., 571 tons; Illinois Zinc Co., 388 tons.

BRITISH COLUMBIA

PROSPECTING FOR PLATINUM NEAR GRAND FORKS.

PRINCE RUPERT.—The tunnel at the 500-ft. level at the Dolly Varden mine has struck the main orebody. The ore assays 80 oz. per ton at the point where the tunnel cut it.

The owners of the Big Missouri mine have arranged to do 12,000 ft. of boring with a diamond-drill during the present summer, and if the continuity of the orebody is

proved by this work a large concentrating plant will be erected. A quantity of machinery that is owned by the Donald Mann interests is to be moved from the Bear River district to the Big Missouri.

STEWART.—Another consignment of about 250 tons of ore has been sent to the Tacoma smelter from the Premier mine. It is expected that shipping will be carried on

nearly the whole length of the drift it is rich enough to ship. Eighteen of the 24 inches of ore is compact sulphide, mostly gray copper with a little zinc-blende. It assays well in silver. Duke Harris has contracted to continue the tunnel at the Erie mine until it is under the shaft, and then to raise and make a connection.

GRAND FORKS.—The Provincial government has let a



THE PORTLAND CANAL DISTRICT, ON THE BORDER BETWEEN ALASKA AND BRITISH COLUMBIA

throughout the year. Machinery for the new concentrator has arrived at Stewart, and is being moved to the mine. Two engineers for the American Smelting & Refining Co. have arrived at Stewart to superintend its erection.

HAZELTON.—A drift has been run for 45 ft. on the new vein recently cut at the Silver Standard mine, near here, and the quality of the ore has greatly improved. Where the tunnel cut the vein the ore was of mill-grade, but for

contract to Mitchell & Co. for a considerable amount of diamond-drilling at Franklin, 40 miles north of here. The exploration is to be done in what is known as 'the black lead', a pyroxenite belt, which was thoroughly sampled at the surface during the War and was found to contain appreciable quantities of platinum, whether in the form of sperrylite or of native metal is not known. The first hole is to be bored between the Maple Leaf and Gloucester properties. Samples taken from the Maple

Leaf property assayed respectively 0.15, 0.17, and 0.38 oz. per ton in platinum. The pyroxenite zone extends almost entirely across the camp of Franklin, and, together with some augite-syenite inclusions on the hanging wall forms the mineral-bearing gangue at the Maple Leaf property. Copper-bearing minerals, principally chalcopyrite, occur in bunches and veinlets through the pyroxenite and syenite and the richest platinum assays were obtained from material in association with the copper minerals. At the Mountain Lion property, however, the platinum appeared to be associated entirely with sulphides and oxides of iron.

ONTARIO

ACTIVE EXPLORATION AND DEVELOPMENT WORK IS EXPECTED AT GOWGANDA.

COBALT.—The McKinley-Darragh company is treating an average of 5000 tons of ore monthly. It is proposed to resume oil-flotation operations about the end of April, this department having been closed down in January on account of the cold weather. From the University property of the La Rose Consolidated, shipments of medium-grade ore have commenced. The development of a quantity of ore during recent months in which the average silver content is about 15 oz. per ton makes this possible. It is announced by the Crown Reserve company that the Porcupine Crown, which it controls, has entered into an agreement to merge with the Thompson-Krist company on a stock basis of two to one, the Porcupine Crown receiving 2,000,000 and the Thompson-Krist 1,000,000 shares. The Porcupine Crown retains control, and also reserves its cash from the consolidation.

The Cross Lake property has been temporarily flooded owing to the water in Cross lake having risen several feet on account of the tailing from one of the customs plants which has dammed the outlet.

Prospectors are active in the Butt township area where last year an encouraging discovery of radium-bearing ore was made. Considerable exploration work is expected to be done in that district this year.

The Cullen-Ferland-Thompson claims in Gowganda have been optioned to R. I. Henderson of Toronto for \$300,000, payable only provided ore is developed. The deal is extremely peculiar owing to it having been closed on the strength of a statement by Andrew Cullen of Haileybury that he has an instrument which enables him to discover ore deposits. The claims of the owner of the instrument are not received seriously among mining men. It is interesting to note, however, that Mr. Henderson proposes to carry out extensive exploration with it, according to report.

A discovery of silver is reported in the township of Pense, about thirty-five miles north-east from Cobalt, as a result of which a small rush has occurred and some 84 mining claims have been staked and recorded preparatory to prospecting.

The Kerr Lake has issued an interim report explaining the recent acquisition of outside properties. The company has bought a controlling interest in a Utah sil-

ver mine which has entered the productive stage, and a gold-dredging property in New Zealand, the annual income from which is estimated at about \$287,000. The company had on hand February 29 cash and Government securities to the amount of \$2,415,027.

BOSTON CREEK.—The main shaft of the Peerless has now reached a depth of 250 ft. where a station will be cut. At the 50-ft. level a drift to the west disclosed a body of rich ore which in addition to gold contained considerable bismuth. At the Kennedy-Boston mining machinery is being installed and underground work will shortly be started, involving an expenditure of at least \$10,000 in sinking and lateral work.

PORCUPINE.—The McIntyre has cut its No. 5 vein on the 1250-ft. level, at which point it is 14 ft. in width and fairly high in grade. The annual report of the Dome Lake shows an operating loss of \$94,524, the mill having been closed down since the end of June owing to a fire. During three months of operation 4433 tons of ore was treated with a total recovery of \$23,832, an extraction of 78.85%. Some changes have been made which are expected to result in increased production.

KIRKLAND LAKE.—During February the Lake Shore treated 1435 tons of ore, producing gold valued at \$40,126, being a recovery of \$27.96 per ton. The Ontario-Kirkland has made plans for the erection of a mill and will carry underground development to deeper levels to open up the downward continuations of ore-shoots occurring on the 300-ft. level. N. N. Maloof has purchased a group of six claims situated south of the Montreal-Kirkland. At the Moffatt-Hall properties comprising about 500 acres in the Lebel Township area, where several veins have been uncovered on the surface, supplies are being taken in preparatory to the beginning of work, which for some time will be confined to stripping, and prospecting with trenches and pits.

GOWGANDA.—A very active season is anticipated as development will receive a great stimulus from the bringing in of electric power and the improvement of transportation facilities. The routes for transmission lines for power from the Indian Chute generating plant on the Montreal river are being surveyed, and it is expected that several thousand horse-power will be available this year. The Northern Light Railways announce that a start will be made on the construction of its line as soon as possible. This type of railway is capable of being constructed cheaply and quickly, and will be sufficient for the requirements of the camp for some time to come. Should the extent of subsequent development warrant, it can be easily taken up and removed for pioneer work elsewhere to give place to a standard railway.

WEST SHINING TREE.—The shareholders of the Wasapika have ratified the reorganization of the company, proposed by the directors, involving the acquisition of additional territory, an increase of capitalization to \$6,000,000, and a change of name to Wasapika Consolidated. Each shareholder will receive three shares in the new company for every share of stock in the original Wasapika company.



THE MINING SUMMARY

ARIZONA

Oatman.—Cross-cutting from the 600-ft. level of the Oatman United shaft will, it is estimated, cut the vein showing on the 400-ft. level. The property is situated between the Big Jim and United and adjoins the Tom Reed.

A face of ore, seven feet wide, averaging better than \$25 per ton, is under development on the 250-ft. level of the Gold Dust. A drift is being carried west to prove the shoot and the orebody will be cross-cut at intervals of 100 ft. to prove its extent.

CALIFORNIA

Plumas County.—At the Gruss mine all efforts are being concentrated on the 400-ft. level and an order for 25 additional miners is being filled. The drift to the north has made considerable progress and the ore is widening. The south drift is proceeding in the direction of the high-grade shoot opened on the 200-ft. level at the rate of six feet per day. The cross-cut east, now out more than 95 ft., has cut another vein that pans free gold and has good copper content. This cross-cut will reach the second contact in the next 40 ft. The Gruss has now five faces of ore on the 400-ft. level, and work is adding rapidly to the mill reserve.

Redding.—A 10-stamp mill has been completed for the Juniper mine at Haydenhill. Sixteen men are employed in the mine and mill.

IDAHO

Coeur d'Alene.—Ore assaying from \$16 to \$50 per ton in lead, silver, gold, and copper has been reached in the south drift, which is being run on the 400-ft. level of the Giant Ledge mine on Prichard creek. The surveys show the vein from 60 to 91 ft. wide. The mill-frame is up, lumber is cut, and a 300-ton concentrator will be built as soon as the O.-W. R. & N. company re-builds its railroad.

Salmon.—The new volatilization plant of the Pope-Shenon Mining Co. is ready for operation, according to C. R. Bradford, secretary of the company. The crushing-plant is in condition for operation, and the smelting plant will be ready to begin work on May 1.

The crushing plant has a capacity of 200 tons per 24 hours, while the one furnace that has been erected will have a capacity of 50 tons per day. As soon as the process has been thoroughly tested, another furnace sufficient to bring the smelting capacity of the plant up to a total of 200 tons will be installed. All necessary material for this addition, except the furnace and the Cottrell treater, is upon the ground, it is said. By the Bradford process the ore is crushed to six-mesh, mixed with cheap chlorides, such as common salt at the rate of one pound of the salt to one pound of metal in the ore, and roasted at a temperature of 700° or 800°. The fumes developed from this roast are precipitated as chlorides by the Cottrell electrical separator. Crude-oil distillate is used as fuel and the collected metallic chlorides melted down to metal in a small furnace on the ground. A recovery of 85 to 90% has been made in experimental tests.

MISSOURI

Joplin.—The St. Louis Smelting & Refining Co. has completed its new mill on the Kropp land, south-west of Hocker-

ville and just south of the Santa Fe mine. The plant will be known as the Kropp mill. It was turned over for the first time about a week ago and regular production is now starting. The Kropp lease is said to be a good one and excellent results are reported from drilling operations.

The Pleasant Valley Mining Co. has been drilling at its mine on the Wyman land south-west of Carthage and has found an orebody that promises to make the mine better than it ever has been in the past. The drilling was begun to determine whether the ore was giving out or had dipped to a lower level. The drills showed that the latter was the case, but that it was better than the run on which the plant had been working. One drill-hole showed a face of ore from 128 to 148 ft. that assayed 15.25% blende, and below that to a depth of 175 ft., ore assaying 7.60% was found.

The Lucky Bill mine south of Cardin, on what formerly was known as the Cornfield lease, has become one of the steady producers of the district, making a good tonnage each week. The Lucky Bill company now is controlled by the Childress brothers of Galena, who took charge of the property last September. The mine was one of the first opened in the Oklahoma field and for some time was regarded as one of the wonders of the district. Water troubles, however, prevented full operation and it did not make the showing expected. Operations now are being conducted at about 250 ft. and at this depth the water does not interfere. One shift is being worked, both in the mine and at the mill, with a weekly production of 60 to 70 tons.

NEVADA

Eureka.—The new vein of galena ore cut in the Eureka-Holly mine last week has widened into a body of high-grade shipping ore seven feet thick, and continues to widen as development continues. Three carloads of high-grade ore were shipped from the mine to the Utah smelters last week. The circulating water tanks for the two new crude-oil engines recently erected were received this week.

Virginia City.—Alexander Wise, presumably representing the Humphrey-Wingfield interests, has acquired the exclusive right to mine the Best and Belcher, Gould and Curry, and Savage mines above the 300-ft. level by the terms of a long lease. The area embraces about 2100 ft. of the Comstock Lode, and a comprehensive sampling of the workings was made before culmination of the deal. To each company a rental of \$8000 has been paid. Development of the lower workings will continue to be done by the owning companies. It is reported in local mining circles that a mill is planned to crush the product from the leased area and other mines controlled by the syndicate. The Humphrey-Wingfield interests are actively pushing work at the Consolidated Imperial, Alpha, Exchequer, Challenge, and Confidence properties, with principal attention devoted to the Imperial. In this property extensive deposits of ore have been exposed and the outlook is good.

Ore sampling \$55 per ton is being mined in the winze recently sent down from the 1800-ft. level of the Con. Virginia. This work is opening up new territory of exceptional promise. Good ore is also under development in other parts of the property and approximately 500 tons per week is going regularly to the Mexican mill.

WASHINGTON

Keller.—"We expect our mill at the Iron Creek mine to be completed and ready for operation by May 15," said J. E. Angle, manager of the property. "Ten men are at work on the plant and all the equipment is across the river and much of it on the ground. Bad roads interfered with the haul. Our compressor will be ready in two or three months. We do not need this now, for we are in soft ground. We have about 200 tons of ore on the dump ready for the mill. The mill will handle 50 to 60 tons per day, but we do not expect to run at full capacity at first."

Northport.—The Gladstone Mountain Mining Co., owning a group of claims near Northport, has sent 46 tons of ore, valued at \$4039, to the Consolidated Mining & Smelting Co. at Trail. Several more carloads of ore were hauled from the mine, but not to the loading point at Boundary, the condition of the roads making progress of the trucks impossible.

Oroville.—A drift on the 300-ft. level of the Kaaba mine has cut a 14-inch vein of high-grade ore that runs parallel with the larger vein on which a shaft is being sunk. The find is considered important as not only adding materially to the quantity of ore in sight, but also on account of the greatly improved grade of the ore.

MEXICO

A. J. McQuatters, president of the Alvarado Mining & Milling Co., which owns a group of mines at Parral, is quoted as saying: "Our plants have operated almost continuously since they first started in 1911, and during 1918-19 we operated without interruption of any consequence. Furthermore, there is not a smelter of any importance in Mexico that has suspended operations as a result of political conditions."

PERU

Oroya.—The Cerro de Pasco Copper Corporation has broken ground for construction of its new smelter to take the place of the old plant at La Fundicion. The plant will have twice the capacity of the old one and be able to handle a daily minimum of 2500 tons. The cost of all improvements is estimated at \$9,000,000. The building will require over 13,000 tons of structural steel and an estimated personnel of 200 to 300 Americans and a large number of native workmen. Two years is the time set for completion of the plant.

QUEBEC

Temiskaming County.—An important discovery of molybdenite in La Corne township is reported. Robert Clark, a Buffalo prospector, has located a block of claims covering 3000 acres stated to contain one of the largest deposits of molybdenite in the region.

MINERALS SEPARATION

The complaints lodged two years ago by the Federal Trade Commission against the Minerals Separation North American Corporation will soon be given a hearing. The complaints charged the Minerals Separation with stifling competition in certain phases of ore concentration; discrimination as to royalties exacted from mine operations, between favored operators and others whom they desire to "discipline, punish, and make examples of", and a number of other matters alleged to be detrimental to the mining industry. The defendants were also charged under the Clayton anti-trust act with making exclusive purchase-selling contracts, fixing prices, rebates, or discounts on condition that the purchasers should not deal in or use commodities of independent competitors. With the exception of the Jackling group of porphyries, the Butte & Superior company, the Magma Copper Co., and a few others, most of the larger mining companies have taken out licenses from the Minerals Separation company.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Rowland C. Feilding is in Canada.

C. A. Banks has returned to British Columbia.

R. A. Archbold has returned to London from Nigeria.

W. A. Noyes has been elected president of the American Chemical Society.

W. A. Howard, manager for the U. S. Smelting company at Salt Lake City, is in New York.

O. B. Smith, owing to ill health, has resigned as general superintendent for the Granby Mines.

E. Mackay Heriot has been appointed manager of the Pena copper mines, in southern Spain.

C. B. Lakenan has returned to McGill, Nevada, after spending a few days at Salt Lake City.

H. B. Tooker, traffic manager of the Jackling properties, was in Salt Lake City and Ely recently.

H. C. Goodrich, chief engineer for the Utah Copper Co., is making a business trip to Chicago and Duluth.

G. Gordon Thomas has been appointed manager for the Jos Tin Area (Nigeria), Ltd., and is now at the mine.

L. K. Armstrong and **John C. Semple** have formed a partnership as consulting engineers, with offices at Spokane.

John S. Stewart has become assistant smelter superintendent for the Katanga Copper Co., at Elizabethville, Belgian Congo.

Shingo Tanaka, of the Department of Finance for the Government of Japan, at Tokyo, is investigating salt industries of the United States.

Charles Janin will sail on the 'Tenyo Maru' on June 17 for the Orient. He expects to be away for five months, and will return by way of London.

Jules Labarthe, of Bradley, Bruff & Labarthe, has just returned from a three months trip to the interior of China, where he has been on professional work.

J. Benton Leggatt, president of the Argyle Silver Mining Co. in the Vipond district, Montana, has returned to Salt Lake City after an inspection trip to the property.

C. E. Nighman, formerly superintendent of hydraulic filling and fire work for the Anaconda Copper Mining Co., at Butte, has become superintendent of the company's phosphate mines at Soda Springs, Idaho.

William G. Devereux, consulting engineer for the W. C. Duncan Contracting Co., and **William H. Mader**, of San Francisco, are at Susanville examining the tunnel site of the Leon Bly Eagle lake irrigation project.

Gus. Scogland succeeds **John Seward** as manager in Salvador of the various properties of El Salvador Silver Mines Co. Mr. Scogland has been manager for the Butters Salvador mines at San Sebastian, El Salvador, for the past five years.

George E. Farish, managing director of El Salvador Silver Mines Co., left El Salvador on March 16 on a business trip to San Francisco and the West, and expects to be in New York during the month of May, returning to El Salvador in the early part of June.

William Weston, well-known mining engineer, and the discoverer of the Camp Bird mine, at Ouray, Colorado, died at his home in Denver on March 30. He was born in London 79 years ago, and came to Canada when 14 years old. He came to the United States, in 1870, and became general traveling agent for the Kansas Pacific railroad. He was later associated in mining with the late David H. Moffat and was widely known throughout Colorado. He leaves his wife, a son, and a daughter.

THE METAL MARKET



METAL PRICES

San Francisco, April 13

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11
Copper, electrolytic, cents per pound.....	19.25
Lead pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$133
Platinum, 10% iridium, per ounce.....	\$140
Quicksilver, per flask of 75 lb.....	\$100
Spelter, cents per pound.....	10
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

April 12.—Copper is quiet and steady. Lead is inactive and easy. Zinc is dull but strong.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.82	106.36
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92
Apr.	95.35	101.12	...	Oct.	101.12	119.10
May	99.50	107.23	...	Nov.	101.12	127.57
June	99.50	110.50	...	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 6	19.25	...	...	Jan.	23.50	20.43	19.25
" 7	19.25	...	...	Feb.	23.50	17.34	19.05
" 8	19.25	...	...	Mch.	23.50	15.05	18.49
" 9	19.25	...	...	Apr.	23.50	15.23	...
" 10	19.25	...	...	May	23.50	15.91	...
" 11 Sunday	19.25	...	...	June	23.50	17.53	...
" 12	19.25	...	...		

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10
Apr.	23.50	15.23	...	Oct.	26.00	21.66
May	23.50	15.91	...	Nov.	26.00	20.45
June	23.50	17.53	...	Dec.	26.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 6	8.85	...	...	Jan.	6.85	5.60	8.85
" 7	8.85	...	...	Feb.	7.07	5.13	8.88
" 8	8.75	...	...	Mch.	7.26	5.24	9.22
" 9	8.75	...	...	Apr.	6.99	5.05	...
" 10	8.75	...	...	May	6.88	5.04	...
" 11 Sunday	8.75	...	...	June	7.59	5.32	...
" 12	8.75	...	...		

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	6.85	5.60	8.85	July	8.03	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02
Apr.	6.99	5.05	...	Oct.	8.05	6.40
May	6.88	5.04	...	Nov.	8.05	6.76
June	7.59	5.32	...	Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79
Apr.	88.53	72.50	...	Oct.	78.82	54.82
May	100.01	72.50	...	Nov.	73.67	54.17
June	91.00	71.83	...	Dec.	71.52	54.94

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	1918	1919	1920	1918	1919	1920
Apr. 6	9.00	...	...	July	8.72	7.78
" 7	9.10	...	...	Aug.	8.78	7.81
" 8	9.20	...	...	Sept.	8.58	7.57
" 9	9.25	...	...	Oct.	8.11	7.82
" 10	9.25	...	...	Nov.	8.75	8.12
" 11 Sunday	9.25	...	...	Dec.	8.49	8.69
" 12	9.25	...	...	

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.58	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.87	6.53	8.83	Sept.	8.58	7.57
Apr.	7.04	6.49	...	Oct.	8.11	7.82
May	7.92	6.43	...	Nov.	8.75	8.12
June	7.92	6.81	...	Dec.	8.49	8.69

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	1918	1919	1920
Apr. 16	85.00	...	...	July	120.00	100.00
Mch. 18	90.00	...	...	Aug.	120.00	103.00
" 23	90.00	...	...	Sept.	120.00	102.60
				Oct.	120.00	86.00
				Nov.	120.00	78.00
				Dec.	115.00	95.00

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00
Feb.	115.00	90.00	81.00	Aug.	120.00	103.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60
Apr.	115.00	73.12	...	Oct.	120.00	86.00
May	110.00	84.80	...	Nov.	120.00	78.00
June	112.00	94.40	...	Dec.	115.00	95.00

MONEY AND EXCHANGE

The rise in sterling has been due to several factors. First, and most important, is the report from London officials that British exports are now running at normal pre-war rate. It is stated that for February, Great Britain's imports were only \$200,000,000 more than her visible exports, but invisible exports more than made up this difference. Secondly, Continental countries that in the recent past have been receiving goods from the United States, are now importing goods from England. Payment for these imports created a demand for sterling bills, with the result that sterling has risen to new high levels.

Although the foreign-exchange market for the past few years has been a sympathetic one, that is, when sterling advanced so did the Continental exchanges, and vice versa, a reversal has occurred the past few weeks. Sterling advanced to new high levels for the present movement, while lire at times were demoralized, and other Continental exchanges declined substantially. The third factor has been the shipping of gold from London to New York. This step has been construed as an indication that England is in a strong financial position, and may, in the near future, resume her regular gold shipments.

With initial shipment of approximately \$9,300,000 British gold bars now in local bank reserves, Wall Street is speculating as to how large the movement to this centre will be. The banker who gave the early information that an extensive gold movement was about to begin in connection with maturity of the Anglo-French loan says that the two shipments reported amounting to about \$20,000,000, are only a small part of what is scheduled to be shipped here during the next few months. He says gold will be coming in until sufficient has been sent to provide payment for the Anglo-French loan in October. It is estimated that at least \$100,000,000 will be sent here by Great Britain and that possibly as much as \$150,000,000 may be forwarded.

Britain's share of the Anglo-French obligation is \$250,000,000. This does not necessarily mean that England must ship gold here to that amount. Great Britain already has some balances in America. She also holds a large amount of American securities, estimated at over \$300,000,000. In international banking circles it was said that if Britain makes substantial gold shipments here it will naturally cause buoyancy in security prices and this in turn will afford England an opportunity to dispose of some of her American securities at higher prices and thus build up credit to meet bond maturity in the fall. The more New York balances she can establish in this way, the less gold she will have to ship.

No official word has been received as to what action France will take in meeting her share of the obligation, although it is felt she too will soon begin to ship gold. A substantial influx of yellow metal from abroad is almost certain to assist in causing easier money rates. If importations of gold should bring about this result Britain might resort to offering a larger amount of treasury bills in this market at the lower rates. These treasury bills are now discounted weekly at 6%. The Assay Office has approximately \$910,000,000 in gold stored in its own vaults and in the vaults of the Sub-Treasury.

Foreign quotations on April 13 are as follows:

Sterling, dollars:	Cable	3.96
	Demand	3.95
Francs, cents:	Cable	5.93
	Demand	5.91
Lire, cents:	Demand	3.80
Marks, cents	Demand	2.10

Eastern Metal Market

New York, April 7.

The markets are all only moderately active largely as a result of the Easter holidays.

Demand for copper has been heavy and prices are higher.

The tin market is quiet, especially so because of the extended Easter recess of three days in London. Prices are strong.

Demand for lead continues in excess of supply and the market, though just now quiet, is very firm.

Buying of zinc is light but prices are steady.

Antimony is dull and slightly easier.

IRON AND STEEL

Increased production, better car supply, sustained consumption both at home and abroad, and lack of evidence in actual transactions of any yielding in the prices at which independent steel companies have been selling finished steel, are the outstanding facts of the week, says 'The Iron Age'.

In spite of all handicaps in cars and fuel, the pig-iron output again increased in March. The total was 3,275,907 tons, or 108,900 tons per day, against 2,978,879 tons in February, or 102,720 tons per day. The March rate means 40,000,000 tons per year, whereas the record for the calendar year 1916 was 39,435,000 tons.

Against the Steel Corporation's bookings for six to eight months ahead, the independent companies have three to five months' business on their books in such lines as bars, pipe, plates, and structural material.

At the annual meeting this week of the Consolidated Steel Corporation, the export company made up of 19 important independent producers, reports showed that March shipments were the best of those of the 15 months since the company was formed. Sales were also better than in February.

COPPER

There have been published estimates in the daily press of total sales of copper in March as high as 400,000,000 lb. These figures are impossible of verification. In reply to a question, the representative of a leading producer said that the sales might have been 400,000,000 or 300,000,000 lb.—“we do not compare notes”—but it is freely stated that purchases have been tremendously heavy, both for domestic and foreign account. The leading producers have advanced their quotations to 19.25c., New York, for electrolytic for April-May delivery, with a slight premium for June, and are not inclined to quote for third quarter, for which at least as high as 19.50c. would be asked. Lake copper is also strong at 19.50c., New York, for early delivery. These prices have been established by sales, though demand just now is lighter as a result of the Easter recesses. The plan for financing foreign purchases is said to be making good progress.

TIN

Due largely to the extended Easter holidays in London, where the market was closed from Thursday to Monday, and also for a shorter period here the tin market has been, and is, quiet. Very little business has been recorded and quotations are largely nominal. Prices have been fairly high, due in part to higher values for exchange. The attitude of consumers and buyers is to purchase on all recessions in values and to remain aloof on all advances. There is a dormant inquiry which will manifest itself, it is felt, on any favorable situation. Yesterday values in London were slightly lower than the day before, spot Straits having been quoted at £359 per ton, or about the same as a week ago. The quantity of tin delivered into consumption in March was 5130 tons with the metal in stocks and landing 2848 tons. The

tin afloat is reported as 2315 tons, which, with that in stock, makes only 5163 tons evidently available for April consumption. It is pointed out that should April consumption be normal then there is likely to be a shortage of supply with premium prices for prompt or nearby delivery. This is due largely to selling tin held at below import cost which has obtained for several months. Tin imports to April 1 have been 13,650 tons against 6341 tons to April 1, 1919. Of this year's imports 10,995 tons came from the Straits.

LEAD

Quietness pervades the market but values are firm—a little firmer than last week if anything, the easing tendency, particularly at New York, having disappeared. This is owing partly to a new harbor strike but also to the disappearance of the cheap sellers and those who are cutting prices. The main feature of the situation in general continues to be a shortage of supply. It is still evident that production is not keeping pace with consumption. Quotations in the outside market are back to 8.75c., St. Louis, or 9c., New York, with those of the leading interest unchanged at 9c., St. Louis, or 9.25c., New York.

ZINC

The market has been exceedingly quiet the past week compared with the erratic conditions of previous weeks. The London market has been less of a factor; it has also been quieter. Producers here are in such a comfortable position that most of them are not interested in selling at present prices. Prime Western for second quarter is quoted at 8.60c., St. Louis, or 8.95c., New York, with one seller offering at 8.50c., St. Louis. Brass special is commanding about $\frac{1}{2}$ c. premium and Grade A about $\frac{1}{4}$ c. premium over prime Western. One prominent producer predicts 10c. zinc by the middle of the year and is very bullish on the outlook. He expects much heavier buying by galvanizers and continued consumption by England.

ANTIMONY

The market for the better grades is slightly easier but quiet. Wholesale lots for early delivery are quoted at 11.37 $\frac{1}{2}$ to 11.50c., New York, duty paid. Other grades are quoted at 10.50c., New York.

ALUMINUM

Quotations continue unchanged at 33c. per lb., New York, from the leading maker and at 31c. from outside interests for wholesale lots for early delivery.

ORES

Tungsten: There is a growing feeling that the tariff bill will be passed and as a result prices are firmer and inquiry is better. The minimum in low-grade ores seems to be around \$6.50 per unit.

Ferro-tungsten is quoted at 85c. to \$1.15 per lb. of contained tungsten.

Molybdenum: Quotations are nominally unchanged at 75c. per lb. of MoS₂ in regular concentrates in a dull market.

Manganese: Foreign ore for early delivery has sold at 80c. per unit, seaboard, and demand is good from one or two interests who contemplate making ferro-manganese.

Manganese-Iron Alloys: Domestic electric ferro-manganese has sold for spot delivery at \$250, delivered, and a small amount of British alloy also. Quotations for the last half remain at \$200, delivered, for American alloy. Only a limited amount of British alloy is available for delivery from August on, at \$195, seaboard. The market is strong but not active. A sale of 250 tons for export to Canada at \$250, furnace, is of decided interest as showing the scarcity of British alloy. Spiegeleisen is firm at \$62, furnace.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

A MODERN ELECTRICAL PRECIPITATION PLANT FOR SILVER-REFINERY FUMES

The electrical system of precipitating fine particles is now used to collect smoke, fume, and dust in a variety of industries, but it is especially useful in connection with metal-refineries because of the high value of the materials recovered. A plant has recently been built in the silver refinery of the U. S. Metals Refining Co., at Chrome, N. J., which is



Fig. 1. Electrical Precipitation Plant

of special interest because it is both a successful commercial plant, and an advanced development of precipitating apparatus. Plants of this type present many engineering difficulties, for not only must practically all of the fume be recovered, since every particle escaping represents a loss, but the material precipitated in the tubes is particularly troublesome. This substance is not a fine, dry, easily-handled dust, as is the case with cement-kiln fume, for example, but a semi-liquid sludge, that is hard to remove, and is especially liable to build up on the electrodes and cause grounds. It also contains a considerable proportion of selenium compounds, which not only attack iron and steel, but ordinary commercial lead also, and only lead free from antimony can withstand selenium-carrying gases. Hence, every part of the equipment with which the fumes come in contact must be covered with chemically pure lead.

The nature of this process is generally known; it consists of passing the dust and fume-laden gases through long pipes; in the centre of each pipe is suspended an electrode charged with uni-directional current of a very high potential (in this case, 65,000 volts). The solid and liquid particles

become electrified in passing through the strong electrostatic field and are attracted to the walls of the pipes, which are grounded. The plant is shown in Fig. 1.

The treater itself is supported on a structural steel framework and consists of three units of 30 lead-lined tubes each. The electrodes contained in the tubes are rigidly suspended from the top so that bottom insulators can be dispensed with.

The gases from the furnaces are first passed through scrubbers and sprayers, which remove a portion of the fumes and cool and moisten the gases to the proper degree. They then pass into the top of a large header, into which the precipitating tubes project several feet, so that irregularities in the gas-flow are prevented. The pipes are heated to the same temperature, and a uniform flow is established through each pipe. After passing through the pipes, the gases, now free from fume, escape into the atmosphere. As soon as the maximum permissible amount of precipitate is collected in the pipes of any unit, the gas flow and the electric current to that unit are cut off, and the precipitate is flushed out of the pipes by a washing system.

The electrical equipment which produces the high-voltage direct current is shown in Fig. 2. There are two units, one for regular operation and one as a spare, each consisting of a motor-generator set, a high-voltage transformer, and a



Fig. 2. Motor-Generator Sets and Rectifiers

mechanical rectifier. The motor-generator set is made up of a 40-hp. 220-volt Westinghouse direct-current motor, and a 25-kva., 220-volt, 60-cycle Westinghouse alternating-current generator. The motor is driven from the power-circuit of the plant and the generator supplies the current for the precipitation system.

The low-voltage current from the generator goes to the transformer, which is of a special design made by the Westinghouse company. It is of 25-kva. capacity; takes low-voltage current at 220 volts, and has taps in the low-tension winding for transforming the current to 55,000, 65,000, 70,000, and 75,000 volts respectively. Its high voltage ter-

minals are of the well known condenser type to protect the transformer-windings against grounds caused by high over-voltage surges during operation. After the low-voltage alternating current has been transformed to high-voltage it goes to the mechanical rectifier which is a simple form of commutator and is kept in synchronism with the current by being mounted on the generator-shaft, changing the high-voltage alternating current into uni-directional current of slightly lower voltage. The high voltage uni-directional current then goes to the treater.

One of the difficulties that must be overcome in this system is the occurrence of high-voltage surges, which originate in the treaters and, if not damped-out, will pass on through all the apparatus in the circuit. To prevent this, carborundum resistance-rods are connected in series with the high-voltage D.C. circuits, and the transformers are protected by means of choke coils mounted within the cases. As the treater circuit is electrically distinct from the power-circuit of the plant, these surges cannot pass back into the latter circuit.

For the convenience of subscribers and others requiring technical books the Book Department of 'Mining and Scientific Press' has prepared a 72-page catalogue of books carried in stock at San Francisco. A copy will be mailed upon request to those interested. A summary of the contents of each book is given and in addition to an index by authors the following grouping according to subjects is made: Assaying, Chemistry, Civil Engineering, Concrete Construction, Cyanidation, Electrical Engineering, Electro-Chemistry, Engines, Geology, Hydraulics, Iron and Steel, Irrigation, Law, Machine Shop and Foundry, Mathematics, Mechanical Drawing, Metallurgy, Mineralogy, Mining Practice, Miscellaneous, Miscellaneous Engineering, Ore Deposits, Ore Dressing, Petroleum, Placer Mining, Prospecting, Scientific Management, Smelting, Structural Engineering, Surveying, and Water Power.

COMMERCIAL PARAGRAPHS

The manufacturing sales-department of the Wellman-Seaver-Morgan Co., which handles the company's sales of rubber equipment and machinery, and which is in charge of L. N. Rideau, moved on March 31, from the company's Akron office to its general offices at 7000 Central Ave., Cleveland.

D. Gleason, manager of the industrial bearings division, Hyatt Roller Bearing Co., announces that his office has been moved to a new building at 100 West 41st St., where much larger quarters have been secured for the advertising, sales, and engineering departments of the division. The new building is conveniently situated and customers are cordially invited to use these offices as their headquarters whenever they are in New York.

'Power Transmission in Principle and Practice' is the title of a neat new publication from the Main Belting Co., manufacturer of Leviathan and Anaconda belts. It presents in concise form the standard formulas and data developed by leading transmission engineers for the selection and use of belts. The service required of a belt determines what kind, grade, ply, and size of belt should be selected. The pamphlet supplies this information in a convenient way.

Charles C. Phelps recently became associated with the Uehling Instrument Co., 71 Broadway, New York, combustion engineers and manufacturers of fuel-economy apparatus. He is devoting most of his attention to research work in connection with the efficient combustion of fuel-oil in boiler-furnaces. It is estimated that nearly \$100,000,000 is wasted unnecessarily every year, due to improper methods of burning fuel-oil, which fact shows the importance of this field of investigation. Mr. Phelps graduated from Stevens

Institute of Technology with the degree of mechanical engineer and has since spent several years studying power-plant problems. Mr. Phelps is an associate member of the American Society of Mechanical Engineers.

The Denver Quartz Mill & Crusher Co., of Denver, has received the following orders: from the Bolivian Mines Co., La Paz, Bolivia, two No. 2 Denver quartz-mills, two No. 2 Denver ore-feeders, and one 8 by 12-in. Denver steel-crusher; from Teats & Co., Paramaribo, Dutch Guiana (second repeat order), one No. 2 Denver quartz-mill and one No. 2 Denver ore-feeder; from M. McCormick Co., Stockton, California (repeat order), one No. 2 Denver quartz-mill and one No. 2 Denver ore-feeder.

'Little David' pneumatic drills, grinders, and saws are described in a recent catalogue issued by the Ingersoll-Rand Co. The company claims that the 'Little David' drill will do more work per unit of power and will take a greater load without stalling than any other drill built for equal duty; that it has at least one-third fewer parts than any other similar drill; and that it requires less attention and costs less to repair than any other drill. It can be disassembled in one-third of the time required by any other make.

To meet the rapidly growing demands of its business the A. H. Simpson Co. is enlarging its machine-shop, installing about \$10,000 worth of new apparatus, and greatly increasing its facilities to ensure immediate delivery of re-built equipment. The new installations, which include a \$4800 lathe and a \$3000 miller, will permit the handling of much heavier work than could have been taken care of in the past. A part of the new equipment will be largely devoted to the manufacture of a new carburetor for use with a low-grade fuel. This carburetor has been in use under various severe tests and conditions and, according to the manufacturers, has satisfactorily demonstrated a marked superiority over present devices for carburetion of low-grade fuels.

A new grain elevator recently finished near Baltimore has a capacity of 4,257,000 bushels, whereas the other seven elevators now in use there have a total capacity of only 10,000,000 bushels. The grain storage capacity at the railroad terminals therefore will be increased nearly 48%. This monster grain elevator is equipped throughout with elevator and conveyor-belted made by the B. F. Goodrich Rubber Co. This represents the largest single order of belting ever shipped and it required seven box-cars to transport it from Akron to Baltimore. The belting totaled 44,254 ft.—approximately 8½ miles—and weighed 131 tons. The capacity of one of the 48-in. horizontal carrier belts is 350,000 bushels in a ten-hour day. Accommodations are provided for the loading of five ocean liners at once, and with the new apparatus for loading that has been installed, the ships can be loaded within 20 hours.

The Flexible Steel Lacing Co. points out some of the reasons why steel belt-lacing is recommended instead of the older kinds. Probably the most important is the feature of time saving. While cemented belt-ends have great strength, the requirement of time and the services of an expert to make repairs have stopped the use of cemented belts wherever they can be done away with. Leather lacing is still in general use, but is constantly losing favor because of the difficulty and delays in making the joint and because of the low proportion of strength which the lacing gives as compared with that of the belt. Alligator steel belt-lacing has the advantages of (1) time saving—the delay caused by a broken belt is practically negligible; (2) strength—the strength of Alligator lacing averages 60% of the breaking-strain of the belt while the average working-strain on a belt does not exceed 20%; (3) high efficiency—permits use of either face of belt in contact with pulley, gives the greatest arc of contact with pulley, is thoroughly adaptable to use on all belts and pulleys of both large and small diameter.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, APRIL 24, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page
EDITORIAL	
NOTES	591
THE REVOLT OF SONORA	592
The Calles revolution and the secession of the State of Sonora. What it may portend. Another Texas? Protests against allowing Carranza's troops to cross Arizona. Our national policy toward Mexico.	
GEOLOGISTS IN THE COURTS	593
Former references to the subject. How one of them was misunderstood. The purpose of criticism. Amending and improving procedure in the courts, especially for apex suits. The need for non-partisan testimony ensuring geologic facts. A proposal to that end.	
COMPLEX ORES IN CALIFORNIA	594
The closing-down of the Afterthought mine, and what it means. How to treat complex base ores containing the precious metals, and zinc. Why recovery suffers from interference of the zinc. The need for producing not spelter alone, but the commercial salts of zinc for local consumption. An invitation to discussion.	
ARTICLES	
THE FUTURE OF INTERIOR ALASKA	
By R. H. Stretch	595
'Interior' Alaska as distinguished from the Arctic and coastal regions. The inhabitants are largely sojourners. The Government railroad to Fairbanks. Present status of mining. Agriculture. Need of a map showing geologic conditions. Stimulation of agriculture desirable. The low-grade ore deposits. Roads to the mining districts required.	
BY-PRODUCT COKE-OVENS OF THE GRANBY CONSOLIDATED COMPANY, AT ANYOX, B. C.	
By W. A. Williams	600
Coke required for smelters produced at the company's own plant. Coal mine at Nanaimo, Vancouver island. Description of the 30 ovens. Regenerators. The by-products department. Arrangement and operation of extractors. Recovery of light oils. Rectification. The products are: coke, gas, tar, ammonium sulphate, benzol, toluol, solvent naphtha, and naphthalene.	
CHLORIDE ROASTING AND LEACHING AT THE PLANT OF THE TINTIC MILLING COMPANY	
By Theodore P. Holt	603
A customs plant treating ore from 20 mines in the Tintic district, Utah. Crushing department. Chloridizing roast in Holt-Dern furnaces. Leaching and precipitation. The recovery of gold is not high. The effect of lime in the ore. Excess is penalized.	
THE SWANSEA MILL	
By F. LeRoi Thurmond	606
Treatment of chalcopryite ore. Crushing in ball-mill. Details of flotation practice. 'Trona' as a flocculating agent. Metallurgical results.	
THE FRICTION OF VENTILATING CURRENTS	
By Walter S. Weeks	607
Ventilation of mines an economic necessity. Fundamental principles. Friction. Measurement of air-pressure. 'Splitting' the air. Regulation of the flow through a system of splits. The value of the constant 'K'. A practical problem in controlling ventilation.	
NOTES	
THE RAKHA HILLS MINES	605
DEPARTMENTS	
REVIEW OF MINING	611
THE MINING SUMMARY	619
PERSONAL	620
THE METAL MARKET	621
EASTERN METAL MARKET	622
COMPANY REPORTS	623
BOOK REVIEWS	624

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.



Though in the heart of the hottest kind of a fire—oil—all the oxy-acetylene welded seams of this tank held tight. The American Welding and Tank Company, Tampa, Fla., its builders, use Prest-O-Lite exclusively.

A TANK THAT COULDN'T BE PUT OUT OF BUSINESS

This 12,000 gallon oxy-acetylene welded oil tank is practically *all* that was left of two burned-down business blocks in Tampa, Florida.

Not only did it withstand terrific heat, but also the shocks of dropping five feet and of having roof and floor beams crash upon it.

The ruggedness of this tank is another tribute to

Prest-O-Lite

DISSOLVED ACETYLENE

THE UNIVERSAL GAS WITH THE UNIVERSAL SERVICE

as an important factor in the efficiency of the oxy-acetylene process.

The domed head was bent in, the 5 inch oxy-acetylene welded supply pipe held fast—*without a leak*—despite the fact that half the weight of the tank hung upon it, even after all the dents were straightened out the welds held tight.

You will be interested in the Prest-O-Lite Service Plan. Write us about it.

THE PREST-O-LITE COMPANY, Inc., General Offices 30 East 42nd Street, New York
Kohl Building, San Francisco
In Canada—Prest-O-Lite Co. of Canada, Limited, Toronto



T. A. RICKARD, Editor

THE Modern Language Association of America has withdrawn its approval of simplified spelling and abandoned the use of it in its own publications. For eleven years the Association has endeavored to reform spelling on the basis of 'simplified' propaganda. We congratulate the Association on its good sense.

RECENT insurgent strikes among the railroad-workers have shown how undisciplined are the ranks of labor. Apparently a radical group made an attempt to disrupt the railroad brotherhoods and the American Federation of Labor. The Attorney General is quoted as having said that he has evidence to prove that the walk-out was "designed to capture American industry, overthrow the Government, and set up a dictatorship like that of Russia". This is a strong statement and we hope that Mr. A. Mitchell Palmer will not delay in giving publicity to his proof of it. The capture of a courier from Lenine to the agitators responsible for the strike is another sensational item that should be either proved or disproved. Loose assertions in such serious matters are much to be deprecated especially if made by Government officials. Apparently the attempt was a blow at unionism as well as industry; it was not preceded by any demands, and no leaders were identifiable; it was a stab in the dark, an act of social sabotage such as we have learned to associate with the enemies of orderly progress in Russia and elsewhere. It is fortunate that the recognized leaders of labor were able to assert their authority and that the force of public opinion killed the revolutionary movement so quickly. We must recognize once and for all that the general strike is tantamount to a revolution; it is a revolt against government in any form; it is the suicide of democratic institutions.

INNATE optimism nourishes the belief that certain silly notions about mining have been outgrown. The doubtful cynic need go no farther than Tule canyon, near Goldfield, to find tangible and ample evidence to the contrary. There he will find a recently finished stamp-mill, completely equipped for operation, with a 24,000-gallon water-tank conveniently situated on the near-by hillside. He will observe also a neat head-frame and hoist, and a dump of excellent rhyolite, which has come from an entirely respectable 60-foot shaft which is as plumb and true as any that ever was sunk. Everything

appears to be in readiness to start hoisting ore. In imagination he hears the stamps falling; he sees the battery-man dressing the plates, and finally he pictures the proud superintendent admiring a big bar of shining yellow gold! Gold? We all know the idea cherished by many old-time prospectors that a particular brand of nature's gold has the amazing faculty of eluding the assayer in some mysterious manner, although its presence in gravel or quartz can readily be 'proved' by the simple manipulation of an ordinary iron pan. Many an assayer has been branded as a fool or a crook because he reported a 'trace' in an 'ore' that had strung the old digger's pan half-way 'round. That is the kind of gold they have at this mine in Tule canyon, and the remarkable part is that after assays actually had been reported as blanks the original owners persisted in backing the evidence of their panning. But that is not all. They needed capital and they finally interested some people who thought it would be romantic to own a mine. These backers fell directly into another blunder which we thought was a memory of a forgotten past. They saw a wonderful opportunity for 'economy'. Why pay a high-priced engineer for looking into so simple a thing as a gold mine? There was the gold, one could see it in the rock! They 'saved' a \$500 fee—and sunk 15 or 20 thousand dollars where they will never get it back. Yes, and another is being born every minute.

ALASKA is a subject that interests most of our readers. We are glad therefore to give space in this issue to an article on 'The Future of Interior Alaska' by that veteran geologist, Mr. R. H. Stretch, whose book on 'Prospecting' has made his name honorably known throughout the West. The physiography and economics of the great mining territory in the north-western corner of this continent are too little understood, even by those engaged in the exploitation of mineral deposits. Mr. Stretch presents the salient facts in a clear and informing manner. We are glad to know that the mismanagement, verging at times on misrule, from which Alaska has suffered, owing to the confusion created by conflict of authority between various Federal bureaus, is shortly to be remedied by submitting Alaskan affairs to a central advisory body. As an example of the annoying and absurd division of authority we may mention that the brown, or Kadiak, bear is under the protection of the

Department of Commerce while the other bears are within the domain of the Department of Agriculture. Mr. Stretch makes a plea for the prospector and suggests the preparation of a map especially suited to his needs. One must acknowledge, however, that the U. S. Geological Survey, more particularly the Alaskan division under Mr. Alfred H. Brooks, has done yeoman service to this mineral region. If therefore any new map is needed or desired by those engaged seriously in exploration or development, we feel sure that it will be provided in due course. No mining territory, it is safe to say, has ever received such persistently valuable scientific assistance as Alaska has received from the Geological Survey. If the other departments of the Government had supplemented that assistance by a properly co-ordinated scheme of administration, Alaska would be in a much better position than it is now. We look forward to an improvement in that direction.

IN this issue we publish the first of a series of articles by Mr. Walter S. Weeks, Associate Professor of Mining in the University of California, on the important subject of ventilation in metal mines. This is a phase of mine operation that has only recently been given proper consideration; it deserves earnest study and we are glad therefore to note that those specializing in this branch of mining engineering are winning an important place in the organization of metal mines. Work in a vitiated atmosphere has been responsible largely for the prevalence of sickness and for the premature breaking down of miners; the necessity for the conservation of manpower and humanitarian considerations alike dictate an effort to maintain good air underground. But there is another and more immediate angle to the problem which is being more fully recognized as a result of intelligent study, namely, the increased daily accomplishment of the miner who is working in a reasonably pure atmosphere and the consequent reduction in the cost of mining. In several mines the introduction of an adequate ventilating system has been given credit for raising the efficiency of operation as indicated by the tons-per-man output by as much as 100%. Other things may have entered into this improvement, but the introduction of suitable ventilating equipment is given as the major factor. It is not always essential to use large and expensive blowers, although a few small mechanical units are generally necessary in order to reach isolated points. Quite frequently fresh air naturally enters the workings through down-cast shafts in sufficient quantity to maintain a satisfactory condition throughout the mine if it be properly distributed. We have known mines where miniature hurricanes raced through the principal connections between the down-cast and up-cast shafts, but where the air in many of the stopes was decidedly poor. The same condition may exist where a large central blower-station draws a good supply of new air into the mine. The problem of getting fresh air into the stopes is complicated by the intricacy of the passages. The position of bulkheads and doors and the adjustment of regulators can only be determined after

careful study; in new work subsequent difficulty can be avoided by driving cross-cuts and raises in accord with the future requirements of a systematized plan of ventilation. The principles of mechanics and physics underlying problems in ventilation are not complicated, but the available data derived from the practical application of these principles are meagre. The present excellent articles are the work of a technician familiar alike with scientific principles and the application of them underground; they will be made more valuable if they form the basis of discussion and elicit information from those in charge of mines, as well as from consulting engineers.

The Revolt of Sonora

Interest in Mexican affairs has been revived by another revolutionary outbreak. Something of the kind was to be expected, of course, because it is customary on the eve of a presidential campaign in Mexico for the candidate opposed to the party in power to protest, usually not without reason, that the purpose of the ballot is being defeated by corrupt proceedings, commonly a tyrannical interference with the process of election. The latest insurrection against Carranza's regime takes the form of a secession of the State of Sonora, under the leadership of General P. Elias Calles. Not content to declare the independence of Sonora, this *revoltoso* has already invaded the neighboring State of Sinaloa and appears bent upon breaking Carranza's rule in northern Mexico. Several States are said to have joined Sonora, and sundry detachments of Carranzista troops have gone over to the rebels. This outbreak, it is reported, has been organized in support of the candidacy, to the presidency, of General Alvaro Obregon, who is expected shortly to assume the direction of the military campaign against Carranza. This, of course, is an old story; some such revolt was anticipated; but it has an interesting phase, because it suggests another Texas. It appears possible that a group of northern States, say, Sonora, Sinaloa, Chihuahua, and Coahuila, may secede from Mexico and form a separate republic, under the friendly protection of the United States. Later either another revolution or an attack from southern Mexico might lead to annexation or absorption of northern Mexico into the American Union. We are not informed concerning the foreign interests that may be supporting General Calles, but inherently it is probable that American mining operators and others on this side of the Rio Grande are giving assistance to the development of a situation likely to bring about conditions favorable to orderly government and the peaceful industry dependent upon such government. Certainly we sympathize heartily with the representatives of Arizona, Senator Ashurst and Governor Campbell, in their protest against allowing Carranza's troops to cross into American territory for the purpose of expediting an attack upon the Calles forces in Sonora. Carranza and his government have forfeited any claim to friendly consideration at this juncture, nor is it in the least desirable, or even endurable, that Mexican troops

should conduct any part of their operations on our soil. To the mining public it would be satisfactory if the northern States, constituting a mineral region of prime importance, were to be separated from the rest of Mexico and placed under a stable government of any kind. In these matters, however, we do not forget that the welfare of the mining business, even the interests of our own readers, must be subordinated to the wellbeing of the United States as a nation. We look askance at any steps that may involve the addition of a large Indian stock to the unassimilated elements that retard the Americanization of our existing population. The inhabitants of northern Mexico are 80% Indian and 80% illiterate; it is to be hoped that before they are driven by the logic of events under the American flag they will have been prepared in some measure for citizenship. Mexico needs an army of Boston schoolma'ams more than an incursion of doughboys. The establishment of a northern republic between the Rio Grande and the rest of Mexico would serve as an intermediary process for benevolent assimilation. The task of true statesmanship is not to expedite, but to delay, the extension of American domain southward and to do it by giving sincere assistance to our neighbors, so that they may educate themselves slowly to a condition rendering possible some form of government better than that of military dictatorship, which, as yet, seems to be the only one applicable to an illiterate people.

Geologists in the Courts

During December and January we referred to apex suits and to the participation of geologists as expert witnesses. This was apropos of the suit then being heard at Salt Lake City, but it referred to a system rather than to an incident. Unfortunately we used a phrase, and we used it twice inadvertently, that has offended several real friends among the scientific men that took part in the Bingham suit. The offending phrase made reference to six good men on one side testifying that something was black while six other good men swore that it was white, that is, that the evidence of honorable geologists was not infrequently so contradictory as to discredit the science of geology and the whole system of juridical procedure, in apex suits more particularly. This criticism was not liked by some of the geologists, and the apposite phrase itself was taken in a sense never intended. It was taken as a personal attack, and it should not have been. We might mention names just to emphasize the absurdity of any charge of a lack of integrity on the part of men for whom we have the highest personal regard, but it would be impertinent. The fact is that nobody likes to be criticized even indirectly and not many remember when their actions are discussed, even as the innocent part of an objectionable system, that the editor's function is to criticize. Literature is a criticism of life; technical literature is a criticism of the life and doings of technicians. We were attacking a vicious custom, one to which the geologist is related as its victim as well as its beneficiary; we hoped by criticism to help in provoking

the demand for a change; in order to criticize we had to run the risk of annoying some good friends. We took that risk, which is the greatest risk an editor incurs. The dozen men we had in mind are professors and practitioners in the front rank of the profession; they are in the grip of a system the defects of which they will be the first to acknowledge. Those engaged in operating mines are becoming sensitive to the absurdity of current procedure in the courts; many of them have written to us urging us to ventilate the matter. To do it effectively we shall need the aid of the geologists themselves. One of them, Mr. Augustus Locke, has acknowledged that there are two kinds of geology, that which concerns itself with the search for ore and that which is devoted to the confusion of the law of the apex. Here we may say that the suggestion has been made that our interest in the matter has been prompted by a noted authority on mining law, whom indeed we can specify as the most authoritative writer on the subject. The suggestion is entirely erroneous; it is as erroneous as it can be. That must suffice. Several mining engineers have discussed the question with us, for it is becoming recognized that much the same group of experts appear in successive cases and that the failure of mining companies to avail themselves as much as they might of the advice of consulting geologists is due in part to the spectacle of conflicting views as aired in the courtroom. Further, the prejudices engendered by partisanship in these apex suits entails a loss to geology in so far as they involve any departure, however unintentional, from intellectual honesty. Can one be partisan and yet intellectually honest in the scientific sense? Can one be a 'good' witness without being partisan? We could not. Lawyers tell us that witnesses usually espouse the cause of the side that calls them. It is human to take sides, even when watching a game, much more when taking part in a contest.

Is it not practicable to devise a method by which witnesses will not be pushed into the attitude of advocates? We think there is, provided those concerned are sincere in their efforts to find an escape from current practice in the courts. Would it not be possible for the two litigants to agree, with the concurrence of the judge, to try their case with the aid of one geologist on each side and a third geologist to be selected by the other two, this third geologist to be attached to neither side, but to aid the judge in clarifying the testimony in so far as it relates to the facts in the case? Or make it two on each side, with a fifth to serve as a detached expert. The geologist thus selected would be chosen for his intellectual honesty, a quality infinitely rarer than commercial honesty and rare even among the best of men; he would be in a position offering no temptation to be otherwise. The procedure would require no act of legislation; it could be adopted by consent of the parties at issue, if the judge concurred, as probably he would, because it would facilitate his purpose, which is to arrive at the truth. It were better to allow the selection to be made by the other geologists than by the judge, because they would be better able to make a good selection. If left to the judge, he would have to

seek advice from among his acquaintances, and thus pass the responsibility to some casual person, probably not without prejudice, personal or otherwise. After all, what is needed is the ascertainment of fact—that is, of such facts as are determinable—for a juridical decision. Usually the harrassed judge is asked to deliver a legal opinion on a maze of contradictory statements, dealing with the highly technical phases of a subject with which he is unfamiliar. More than once the court has expressed surprise and chagrin at the contradictions involved in expert testimony from opposing litigants, and acknowledged the difficulty of reaching the right decision upon such an insecure basis. We are confident that mine operators and consulting geologists will find the courts not unwilling to give a favorable hearing to the suggestion of any method that will expedite their work and facilitate their function. One thing is sure, the descriptions and explanations of such a court geologist, that is, of one selected to be non-partisan, would at once become valuable technically; they would form the basis for a reference library of mining geology, in a manner quite impossible so long as men of the highest character are marked as partisans from the start by the fact that they appear in court to support one side of a controversy. We commend the subject to the attention of our readers, especially those most concerned, and we hope to receive a statement of their views for publication.

Complex Ores in California

The recent closing-down of the Afterthought mine, in Shasta county, again calls attention to the fact that scattered along the Sierra Nevada in California are large and small deposits of complex sulphides that are not being exploited. These ores carry gold, silver, zinc, copper, lead, iron, manganese, calcium, barium, and other elements in subordinate amounts, the precious metals in some instances being present in quantities sufficient to be attractive even when considered apart from their base associates. Inasmuch as none of these properties are being operated at the present time, although some of them are equipped with extensive plants of expensive machinery, it can be assumed that the metallurgical methods used did not produce satisfactory commercial results, particularly as ample capital was provided for all requirements. If this deduction is correct the question then arises: Wherein have the metallurgical processes adopted been at fault? Taking the Afterthought mine as a typical example of these Californian complex sulphide deposits, reference to the files of the 'Mining and Scientific Press' shows that a number of methods of treatment have been tried at intervals, and as each effort resulted in a shut-down, it can only be assumed that conditions at the property were not met successfully. The presence of a large amount of zinc in the ore interfered with the recovery in two ways: (1) it made smelting difficult, if not impossible when the output of the mine as a whole is considered; and (2) the value of the contained zinc was proportionately too great to permit the

ore being treated for the other metallic contents alone. The zinc in these ores must be put in a form in which it will contribute to the economic result and cannot be thrown into the discard. In addition to its separation from the associated metals, it must itself become an asset, and not a liability, if mineral deposits of this character are to be profitably exploited. It will be noted, in reviewing published accounts of metallurgical operations on complex sulphide ore in California where zinc is a prominent feature, that in almost all cases a concentrate was produced that had to be shipped to some distant point for further treatment, or else an attempt was made to convert the metal into spelter. In only a few instances, in this State have the salts of zinc, such as zinc oxide, zinc sulphide, and zinc chloride, been manufactured. In California there is a comparatively light demand for spelter, but, on the other hand, the oxide is used in large quantities, as is also the chloride, and the outlook for zinc sulphide as an important ingredient of 'rubber' tires is promising. Zinc oxide is brought from New Jersey or Kentucky. The problem of the complex zinc sulphides will be solved sooner or later, and, in view of what already has been done in this direction, the proper mode of procedure would seem to be to convert the metal from ore into salts of zinc which command a higher price per pound of contained metal than is paid for it as spelter. In the case of the Afterthought, determined efforts have been made to discover some means of utilizing the large body of complex sulphides locally available. Evidently, from published accounts of what has been done recently, flotation methods were not successful. Flotation simply produced a concentrate that found its nearest market in Oklahoma. We presume that the management, before closing down, carefully considered all means of keeping the plant in operation, if for no other reason than to avoid such rapid deterioration as inevitably overtakes an idle metallurgical establishment; but we have not seen in any account of the operations to what extent zinc can be removed from the 'collective' concentrate by giving it a sulphatizing roast followed by leaching with acidified water derived from passing the roaster-fume through suitable towers. Once a portion of the zinc is obtained in soluble form, it can be thrown down as any desired salt by chemical precipitation, and, if not the whole, at least enough of the metal can be recovered in this way to release the associated metals for furnace treatment. Objections to the sulphatizing roast, if set forth under 'Discussion', might elicit other suggestions on the part of our metallurgists which would assist in solving the difficulty. As it is a function of a publication devoted to mining and scientific matters to lend what aid it can to the furtherance of the interests it represents, a frank and free discussion of the causes that have led up to the shut-down of the Afterthought, and similar properties, cannot but be beneficial to all concerned. The idleness of these mines is a serious detriment to the mining industry on the Pacific coast, and we believe a remedy can be found if the cause is purely metallurgical. We invite discussion.

The Future of Interior Alaska

By R. H. STRETCH

INTRODUCTION. Since the first day in which the Territory of Alaska was recognized as a valuable asset of the United States, it has been the custom to speak of it as a unit. As a matter of fact there are three Alaskan territories differing so radically in topography, climate, resources, and social conditions that no general description will convey a true conception of any one of them. The Alaska Bureau of the Seattle Chamber of Commerce has done magnificent work in dissipating the old erroneous conception of a worthless frozen land of ice and snow, stupendous glaciers, and terrific blizzards, but it has not dwelt on the essential differences between the coastal region and the interior. The purpose of this article is to supply the deficiency. The vast majority of tourists see but one side of the picture, and but little of the economic questions that bear so heavily on the other.

COASTAL ALASKA embraces all the region from Ketchikan in the extreme south-west to Unimak island in the extreme south-east, a distance of 1500 miles, and extends inland to the summit of the Alaskan range. It is essentially a mountainous area, with varied resources; immense fishing industries, valuable mines of coal, oil, gold, copper, lead, zinc, marble, gypsum, and barite; extensive forests and potential wood-pulp enterprises, with considerable areas of agricultural land in the Chilkat, Copper River, and Suisitna valleys, as well as many spots suitable for truck-farming among the islands of the Alexander archipelago; but it is not primarily a farming region.

ARCTIC ALASKA lies north of the Endicott mountains, and all its streams flow into the Arctic ocean. Although known to possess coal, asphalt, oil, and more or less gold and copper, its present commercial resources are furs and whales, which have no bearing on this discussion.

INTERIOR ALASKA is co-extensive with the entire basin of the Yukon river and its tributaries, from the Endicott mountains to the Alaskan range, and from the Canadian boundary to Bering Sea, into which the river system empties. Aside from furs, its exports to date have been chiefly gold, with small amounts of tin, antimony, and tungsten. There are enormous deposits of lignite, but no known deposits of iron, neither are there forests of commercial timber so that the outlook for manufacturing industries is not promising. It has, however, wide areas that have been proved capable of growing most of the products of the temperate zone, including the hardier cereals. These conditions point to the development of its farming resources as the road to prosperity. While Coastal Alaska has a heavy rainfall and a moderate range of temperature, Interior Alaska has only a light rainfall, with long cold winters and hot summers, or, in other words, a climate of the continental type. Its ocean front-

age on Bering Sea and its entire river system are frozen for at least half the year and communication with the outside world in winter has been possible only through three passes (practically one) in the southern mountain barrier; by dog-team in the olden time, by horses at a later date, supplemented today by automobiles. Importation of heavy goods in winter has been impossible and mail-service has been cut down to letters and a very limited amount of printed matter. Daily communication is maintained by telegraph and wireless.

AREA. The total area of Alaska is a trifle less than 600,000 square miles, equal to one-fifth the total area of all the other States combined, twelve times the size of the State of New York, or ten times the area of England! Leaving out the islands it is a compact body of land roughly 700 by 800 miles. The portion occupied by the Yukon Valley or Interior region is probably about one-third the whole.

POPULATION. On account of the migratory character of the population, due to the rise and fall of mining centres, it is difficult to arrive at an accurate estimate of its numbers. An analysis of the so-called white population (usually given as 45,000 to 50,000 in a normal year before the War), indicates a population of from 12,000 to 15,000 persons in the Yukon Valley and Arctic Alaska. It is not easy to say how many of these should be assigned to Nome and the rest of the Arctic zone, but it seems safe to say that not more than 12,000 were settled in the Yukon Valley. This means one person per 17 square miles. Since the War the population has been depleted, so that there is small chance of this sparsity being exaggerated. The census will give no idea of the summer population, because every miner who could do so has apparently gone south for the winter and will be counted in some other community.

This handful of people, it is scarcely correct to call it a community, is isolated from the rest of the world by a wilderness, so that its only contact with the outside world is by ocean and river steamers and the 110 miles of the White Pass & Yukon Railway. Every link in these lines of transportation is handicapped by physical and social conditions unfavorable to an economical service. Nowhere is it possible to get the full measure of efficiency from any of the costly equipments. Especially is this the case in the Yukon Valley, where the boats are idle more than half the year, with a long list of fixed overhead charges to be borne by a traffic that is one-way only, as far as freight is concerned. Omitting gold, Alaskan exports for October 1919 exceeded \$19,000,000, but not one dollar of this came from the Yukon Valley!

No distributing industry can be run to the full capacity of the plant under such conditions, when its life de-

depends on the patronage of the public; high prices for the service must inevitably result. The newspaper can just as well run off thousands of copies instead of an edition of a few hundred; the cook in the restaurant is never busy to his full capacity; the movies can as easily serve audiences many times larger, and the light and telephone system a much greater clientele, while every merchant is expected to keep a good assortment on his shelves in spite of his small daily turnover. These are conditions incident to all small communities far from large centres of population and are not peculiar to Alaska, but perhaps they are felt there more acutely because the population is largely made up of miners who demand the best of everything. This is reflected in the fact that until quite recently the smallest coin in circulation was the 25-cent or 'two-bit' piece. The use of lesser denominations was looked upon as the end of the good old times, a sign of decay! It seems likely that while natural obstacles may have affected freight-rates, the difficulties attending the distribution of the freight and the necessities as well as the luxuries of life to the ultimate consumers, so few and so widely scattered, may be the dominant cause of the high cost of living, that is simply intensified in the interior.

We call these Alaskans 'pioneers', and in the sense that they are on our last frontier they are entitled to the honorable name, but the present generation is in no other sense comparable with the men who pushed westward into the great unknown a hundred years ago. Those were building homes for themselves and their descendants—the Alaskan pioneers have been more like Kipling's 'Gentlemen Rovers', leaving expensive tin-cans along the trails instead of their bones. The present race wants good clothes instead of homespun and buckskin; they have tasted the luxuries of civilization and must have the fruits of the tropics as well as the produce of their own acres; electric lights instead of a home-made tallow candle; the daily newspaper instead of the gossip of a chance wayfarer; automobiles instead of an ox team; the whole gamut, in fact, of modern inventions and appliances in place of the humdrum life of their prototypes unrelieved by anything more exciting than a house-raising bee for a new settler. Those men were content to be out of the world and by the world forgotten; their successors in the north must have a digest of the happenings of the entire world on their breakfast table, or feel that they have been cheated out of their just rights; and what is more, they want these things at a much lower price than they are now paying for them. Unfortunately there seems but small hope of their wishes being realized for years to come. Few of these men went to Alaska with the intention of becoming attached to the soil. Like all the rest of their fellows they sought a competence where apparently it was to be found as promptly as possible, and it is nothing to their discredit that when successful they should select a home for their mature or declining years on the 'outside'. They cannot be called quitters for they never intended to stay, neither can they be expected to stay when they can so easily become part and parcel of

the surging humanity of more crowded centres and more genial climes. When in Alaska they naturally drop into four classes or groups: miners, farmers, merchant distributors, and operators of public utilities. The last three at this writing are entirely dependent on the first; when mining is prosperous all share in the prosperity; when the mining population decreases there are fewer mouths to be fed from the surplus products of the farms; there is a lessened demand for clothing and imported articles, and less money to spend on telegraphs, telephones, light and water service, newspapers, and theatrical amusements. When any purely mining camp is dead all dependent life dies with it.

The building of the Government railroad from Seward to Fairbanks, while projected as a business enterprise to open up the coal deposits, was undoubtedly underlaid by an altruistic idea that easy flight from the long winter nights might stem the tide of annual migration on the theory that when you find that you can easily do what you wish to do, the desire to do it fades away. It is too early to say what the result may be in holding the present population of the interior or of increasing the same, but it may be profitable to see if it is likely to accomplish this result in any appreciable degree by reducing the cost of living and operating.

Three definite ideas underlaid the scheme. First, the opening of the Matanuska coal-field; second, the opening of the Susitna valley; third, the relief of the interior by building a railroad from Broad Pass to Fairbanks, a distance of about 150 miles. As the road is less than 500 miles long, and is costing \$52,000,000, it is not unfair to assign \$15,000,000 as the sum to be accounted for by the Interior Zone, or Yukon Valley. Interest on this sum at the rate of 5% and depreciation at the same rate, together with yearly maintenance and operating costs, to say nothing about interest on the millions lying idle during the period of construction, will easily range somewhere between one and a half to two million dollars, while the imports to the interior, as shown by the Custom House returns for the fiscal year ending June 30, 1914, were \$2,603,123; for 1915, \$2,176,668; for 1916, \$3,533,206; for 1917, \$4,561,526; and for 1918, \$1,839,173. In 1916 and 1917 the figures were swelled by large amount of railroad-construction material sent to the interior end of the line, which cannot be included in the ordinary demand, leaving an average for the other three years of \$2,172,988. As there is no important source of return freight in sight it is clear that unless we are prepared to meet a heavy deficit, the freight charges must be nearly equal to the declared value of the goods to say nothing of the ocean freight and charges on the southern portion of the line.

This is, however, only a part of the story. The railroad merely takes goods from the outside to a point in the interior, by a new route on which vastly more money has been spent than was invested in the old, and must then depend on the old river transportation system, over which it has no control, for their distribution. So far as appears from the above facts the chief advantages accruing to the Yukon population will be more convenient ways of

getting out of the country, and the saving of money due to their ability to carry smaller stocks and replenish them at any season of the year. In all other respects winter conditions will remain the same until east and west lateral railroad lines afford new facilities.

Through the irony of fate, a project based on the improvement of conditions round Fairbanks has resulted in no small part of that town moving bodily to the new town of Nenana, where the railroad first strikes the valley. Fairbanks is no longer the central distributing point. It is time that we take an inventory of the assets of the Interior Zone, so that we may intelligently undertake its future development.

PRESENT STATUS OF MINING. Were it not for the discovery of gold the Yukon Valley would still be a wilder-

would not have changed the figures so suddenly. The richest and most accessible deposits only, can be worked today, the ability to work the poorer ones when better transportation facilities were available has been lost in the steady advance in the cost of living. The oft quoted 13c. as the average yield of dredging in California is no longer the keynote.

These things have also borne heavily on lode-gold mining near Fairbanks, causing suspension of work at many mines. Finally, the interior has been rapidly depopulated by the demands of the War and the abnormally high wages paid in war industries; the population is yet far from the normal 12,000 to 15,000, although it is increasing slowly.

The agricultural industry is so intimately dependent



ness. It was the placer gold that attracted the first adventurers, and placer mining today is the dominant industry. As it prospers, so do all others; as it declines, the others wane. Lode mining for gold is conducted on a limited scale near Fairbanks under harsh conditions, and small shipments have been made of tin, tungsten, and antimony, but the price of the last two metals has fallen to a figure rendering export unprofitable, while the increased costs of all materials employed at the placer mines, as well as the higher cost of labor, have rendered much ground valueless that in normal times might have been economically worked. These things are curtailing the gold output all over the world and the Yukon Valley is not the only sufferer. A material reduction in the annual shipments, due to gradual exhaustion as indicated by the returns, was to be expected, but this cause alone

on mining that anything affecting the prosperity of the one is reflected in the status of the other. Farming in the interior of Alaska is confined to truck-gardening, the eatable vegetables being sold to the adjacent mining community, while the hay and grain is fed to the stock on the farms or at the mines. The extent of the industry may be judged from the following data. Allowing an average consumption of 1000 lb. of farm products per capita, and an average yield of only 5 tons per acre under intensive cultivation, we have a required production of not to exceed 7500 tons, requiring 1500 acres for the total quantity, equal to 15 farms of 100 acres or 150 farms of 10 acres. This area is about $2\frac{1}{2}$ square miles out of an estimated available area of 50,000—showing clearly that the industry is in its babyhood. To load a vessel of 3000 tons burden with cereal products, we must have a 25-bushel

crop weighing 60 lb. per bushel on 4000 acres. It is evident that some years must elapse before this is possible, as the land is not yet cleared; it is also evident that the mining communities must enlarge greatly to furnish a living to the farmer while this is being accomplished.

Betterment of the mining industry is the first thing to be attempted. As the prospector is today, as he has been in the past and will be in the future, the searcher for new mineral, anything that will guide him in his arduous labor, preventing lost years and useless wandering in regions where neither mineral lodes nor placers are likely to be found, is of prime account. The short summer, the generally inaccessible character of the country to be explored, the absence of trails, and the dense vegetation make his task anything but a picnic. He may be an intelligent man yet unable to understand the technical language of science while perfectly able to read a good map, so that a graphic illustration, with a lucid explanation in simple English, will be of greater service than a library of scientific bulletins. The following suggestion appeals to me.

It is an accepted proposition among scientists that the upward thrust of bodies of molten or plastic rock into the overlying stratified or water-laid rocks has played a most important part in the mineralization of the latter through the solvent action of the superheated water or steam in the former. We may safely accept the truth of this axiom without going into the question as to how the minerals were dissolved by the water or precipitated therefrom. It is here sufficient to say that the staff of the U. S. Geological Survey accept this view, and that the gold deposits of Alaska owe their origin, in large part at least, to tremendous intrusive action in the early part of what is known technically to geologists as the Mesozoic era, which word means 'middle life' and indicates that the time was mid-way in the history of life on our planet. Rocks laid down later than that time could not have been affected because they were non-existent. The older rocks have therefore a special interest for the prospector and mining geologist as being most likely to contain metallic deposits of value.

Through years of patient labor, which only an enthusiast can appreciate, buffeted by storms as they forced their way through the unbroken wilderness, the staff of the Geological Survey have delimited the area of these rocks with accuracy sufficient for our purpose, and a map of the Yukon Basin showing these delimited areas would be a most valuable step in forming an estimate of the probable future of the gold industry in the Interior Zone, valuable alike to the prospector and the operator. The position of the intrusive rocks should be shown in strongly contrasting color. In a more subdued tint it would be well to show the areas of the consolidated rocks laid down since the Mesozoic disturbance, for while they could not be affected by it, later intrusions may have mineralized them to some extent and along different lines. In both areas all mineral deposits should be indicated of which mention is made in the bulletins of the Geological Survey, and the streams that have yielded placers might

be brought out prominently by a heavy black line. The rest of the map would be left uncolored. Such a map would probably be a surprise to many people who imagine that gold is to be found everywhere in Alaska, but while it is true that 'float' gold in small particles is carried by the streams in flood-time and widely disseminated, there are large areas in which the probability of finding 'pay' is so slight that prospecting in them would be a waste of time and energy. A broken line might show the limit of recent glaciation.*

The dominating idea should be to make the map as simple as possible, but a long step forward would be made, through the aid of the Agricultural Department, if those lands suitable for the plough, as distinguished from grazing, could be shown in light hatching. We could then see at a glance the economic relation between the two industries, a point of no small value when we stop to consider the dependency of one on the other. If such a plan should be found too complex, the same base map might be used by each department, on which to impose the necessary coloring, so as to avoid the annoyance of consulting the scale of the respective maps.

The Agricultural Department would do good work by issuing an economic bulletin to accompany the suggested map. It has done magnificent work and is deserving of unqualified praise, but in the very nature of things, the plots of ground on which the experimental stations were established were selected because of their supposed suitability as regarded soil, sunshine, wind, and date of killing frosts. They have demonstrated what will grow; what we now want to know is the whereabouts of similar lands, especially in the area surveyed and subdivided by the Government, so that we may be able to judge of its proximity to local markets and the northern terminus of the railroad line; the time necessary to clear an acre in terms of day-labor; the amount and type of fertilizers, if such are needed, to correct soil-acidity or other defects; the average yield per acre of the various cereals, vegetables, and root crops; the frequency with which a crop-failure may be expected, and what pests or diseases must be held under control or exterminated. The information contained in the bulletins on soil-surveys should be condensed into the language of daily life bereft of scientific technology as completely as possible, and the information furnished by voluntary observers scattered through the agricultural reports should be collected and tabulated. Crops for fodder should have a special notice, as also the small fruits that grow luxuriantly and might possibly furnish exportable products. Dairying in all its

*With such wide distribution of the metal it seems strange that the natives did not know more about it. When compiling a map of Alaska in the autumn of 1897, to supply the demands of the gold-seekers, I used the narratives of Schawitka, Dall, Allen, Stoney, Townsend, and others, and found no reference to it. Stoney foreshadowed the discovery of asphalt in the Colville region, Dall intimated the occurrence near Goodnews Bay of rocks similar to those near Dawson; and Townsend mentions iron and a contact of slate and granite rocks near the headwaters of the Kobuk river, on the strength of which I indicated that region as a possible gold district.

branches should be discussed for similar reasons, with information on silage crops and the cost of wintering not only cows and horses, but hogs and chickens; in fact, the bulletin should cover all topics relating to the food-supply of the community.

Returning to the prospector, it should be remembered that there have been no inducements to seek for metal lodes. When large and low-grade they offered little inducement to large capital on account of the excessive cost of transportation and development. The effort to work the known lodes has been confined almost entirely to Fairbanks, and in that district the veins are of a type that calls for the closest economy in the management and a thorough knowledge of practical mining. While the grade of the ore is good, the tonnage has been small and most of the properties are waiting for brighter days. Good prospects in the Kantishna have been unproductive

In my opinion a great mistake was made when a standard gauge was adopted beyond Matanuska Junction. A potential heavy traffic from the coal-fields was expected from that point south to the seaboard, but from the junction northward the line was purely exploratory, and a 3½-ft. gauge, like that of the White Pass & Yukon line, would have doubled the mileage for the same amount of money and have supplied a greatly increased area. Action must be prompt and liberal so as to get the good work started before the completion of the main line, because that will result in the dispersion of the working gang and a material decrease in the number of mouths to be fed by the local farmers. How complete this dispersion is and how great may be its effect on local interests was exemplified at Cordova when the railroad from that point was completed. The number of saloons dropped from 27 to 2, and other business suffered equally.



CHICKALOON MINE IN THE MATANUSKA COALFIELD, ALASKA

since their discovery a good many years ago. The prospector cannot afford to pay the fee and expenses of an expert whose report would command attention, and the capitalist will not listen unless he has such a statement before him, so that a lode-claim is to the prospector like the gift of a white elephant.

The interests of the farmer must also be studied and every possible inducement given to locate in the north. Land should be absolutely free and untaxable for a number of years. Seed of the crops best suited to each locality should be furnished free of cost by the experimental stations and farm machinery made available, as for some years to come there will be a scarcity of human labor at crucial periods, because harvest-time comes just when the placer miners are working at their seasonal clean-up.

This measure of success can alone justify the building of the Seward-Fairbanks railroad unless we look at it as a military necessity. That it must be finished and with all possible speed goes without saying, but its effect on the community will be very limited until trails and roads have been built into the mining districts; and good roads or even branch railroads into the agricultural sections.

We must be prepared to show many of these workers why they should remain in the country.

That there is a wonderful potential wealth of agriculture in the Interior Zone is beyond doubt. The difficulties in the way of making it available to the nation have been submitted to the limelight to see if they actually cast impenetrable shadows, or if we might thread our way between them and realize our hopes. No worthy enterprise has suffered from the truth being told, but so that there can be no possible misunderstanding I repeat that this article deals only with the central portion of Interior Alaska and must not be taken as a statement of conditions existing in the Littoral Zone, in which they are entirely different and infinitely more favorable at this date. The Interior Zone has produced for export only gold and a small amount of other minerals; the Littoral Zone has sent out gold and a large amount of other metals and fed hundreds of thousands from the products of the sea. All Alaska, however, suffers equally from the fact that a pitifully small portion of the wealth taken both from land and sea remains within its boundaries. The vast bulk has gone outside to build up other communities.

By-Product Coke-Ovens of the Granby Consolidated Company, at Anyox, B. C.

By W. A. WILLIAMS

*The Granby Consolidated Mining, Smelting & Power Co. is the largest producer of copper in British Columbia and consumes an average of 250 tons of coke per day. Beehive-oven coke was formerly bought, and the shipments were often considerably delayed and the proportion of breeze was excessive, causing great inconvenience in the operation of the smelter. To secure a more reliable supply, the company decided to produce its own coke. A modern coal mine was put in operation at Cassidy, a few miles from Nanaimo on Vancouver island, and a coking-plant built at the smelter. The coal is screened at the mine, the marketable sizes sold, and the slack washed and shipped to the coking-plant.

Barges holding about 2000 tons carry the washed slack to the coke-plant, where it is unloaded by a steam-hoist operating a one-ton bucket having a capacity of 120 tons per hour. The bucket is emptied into a hopper, from which the coal is carried by a 30-in. belt to the top of the 12,000-ton storage-bin, where it is distributed by another belt running along the top of the bin. The bin, built entirely of wood, is 300 ft. long and 51 ft. wide, with a V-shaped bottom. From the bin, the coal is taken by belt-conveyor and elevator to the crusher, which is one of the swing-hammer type and has a capacity of 50 tons per hour. The coal is crushed so that at least 90% will go through a $\frac{1}{4}$ -in. screen and 80% through $\frac{1}{8}$ in. A bucket-conveyor takes the coal from the crusher to the 500-ton bunkers over the ovens. The coal is drawn from the bunkers into a lorry equipped with four cone-shaped hoppers, the combined capacity of which is 13 tons, just sufficient to charge one oven.

The 30 ovens, having a capacity of 270 tons of coke per 24 hours, were designed by the Gas & Coke Oven Co. of America. Their special feature is the substitution of vertical flues for horizontal flues. The dimensions of the coking-chambers are 37 ft. 4 in. long, 9 ft. 10 in. high, 18 in. wide at the pusher side, and 21 in. at the coke side, with a capacity of approximately 13 tons of coal. Regenerators are situated under the ovens, one regenerator-chamber under each oven. A heavy wall separates the regenerator-chambers from each other and upon this wall rests the oven-heating wall. This oven-heating wall is made up of 30 vertical flues, each two adjacent flues forming a complete unit. Situated beneath these vertical flues are two ducts that feed gas to them through removable nozzles. These horizontal ducts are so divided that 14 of the vertical flues receive their gas from the coke side and 16 from the pusher side. The regenerators are

connected to waste-heat flues paralleling each side of the battery, and are so divided as to furnish air to, and receive the products of combustion from, these flues, receiving gas from the same side.

The regenerators are divided into an upper and lower section by means of a horizontal partition extending from the front of the generator chamber to within 18 in. of the back wall. Thus any tendency of the air and products of combustion to short-circuit is avoided and their travel increased. The efficiency of the generator system is greatly augmented by having this regenerator-chamber, through which the combustion air is being drawn, sandwiched between regenerators, through which the products of combustion escape, thus effecting what might be called a combined regenerative and recuperative system.

The pusher was built by the Atlas Industrial Car Co. of Cleveland, and comprises door, extractor, pushing-ram, and leveling-bar. The coke guide and door extractor on the coke side are hung from an overhead track. The quencher-car, with its load of red-hot coke, reaches the quenching station; the water is automatically turned off when the car leaves the station. After quenching, the coke is taken directly to the screening-station where it is separated into furnace and breeze coke and loaded directly into cars. The handling is greatly facilitated by the fact that, owing to difference in elevation of the quencher and loading-tracks, the cars are loaded by gravity.

The gas is reversed each half-hour, burning in one flue of each unit for half an hour, and in the other flue for the next half-hour. Thus we have combustion taking place in every alternate flue the whole length of the oven-wall. The size of the opening connecting the two flues comprising a unit is regulated by a slide-brick, thus controlling the air-supply to that particular unit. Above each flue is a hole through which the condition and temperature of the wall may be observed. The openings leading from the regenerator to the stack-flues are provided with dampers so that the draft to each regenerator may be regulated.

The incoming combustion-air is regulated by the use of finger-bars. There is a damper in each stack-flue just before they unite into a single flue at the stack-end of the ovens. The single flue that leads to the stack also contains a damper. The stack is built of radial brick. It is 177 ft. high and 9 ft. 8 in. diam. at the bottom and 7 ft. diam. at the top.

The gas is conducted from the oven-chamber through 14-in. cast-iron ascension pipes to the collecting main, which is 4 ft. 4 in. wide, and 4 ft. 9 in. deep at one end

*A paper read before the Canadian Mining Institute at Vancouver on November 27, 1919.

and 5 ft. 8 in. deep at the other, with a semicircular bottom. The uptake main is 28 in. diam. and continues just beyond the bunkers, where it enters the downtake, which is 24 in. diam., and thence along the ground by the by-product building.

A hand-valve to control pressure in the collecting-main is placed just before the downtake. The temperature of the gas is considerably reduced in the collecting-main and the heavier particles of tar and liquor condense and escape as a liquid. To keep the main free from thick tar and pitch, fresh tar is continuously circulated through it.

On reaching the by-products building, the gas enters the primary coolers, of which there are three, each containing 594 three-inch outside-diameter lap-welded steel tubes 17 ft. long. The water flows through the tubes and the gas around them. The temperature of the gas is re-

duced at the rate of eight gallons per ton of coal. From the extractors the tar-free gas goes to the saturators, which are lead-lined cast-iron containers, where it is made to pass through a bath containing 5% to 7% sulphuric acid. The ammonia in the gas reacts with the acid to form a white crystalline salt, ammonium sulphate, which settles to the bottom of the saturator and is removed to the drain-table by means of an air-ejector. From the drain-table the salt is conducted to a centrifugal dryer, where it is washed with water to remove the free acid and then dried.

The liquor and the tar which condenses owing to cooling of gases in the various parts of the process are pumped to a separating-tank of 45,000 gal. capacity, where the tar and liquor separate by specific gravity. The liquor overflows into a 50,000-gal. tank and the tar is drawn off from the bottom to a 200,000-gal. tank. The tar is pro-



THE COKING-PLANT OF THE GRANBY CONSOLIDATED COMPANY, AT ANYOX, B. C.

duced to 32°C. and most of the tar and liquid is deposited. The gas now enters the exhauster, whose function it is to maintain an even pressure in the collecting main and to force the gas through the remaining apparatus. The exhausters, three in number, were built by the Connersville Blower Co., and are driven by 10 by 10 in. vertical self-oiling Troy steam-engines, equipped with Hunton float-governors so as to maintain a pressure of 1 to 2 M.M. in the collecting main.

The exhausters have a displacement of 17 cu. ft. per revolution and are designed to operate at 250 r.p.m. against a total plus and minus pressure of 2½ lb. per square inch.

After leaving the primary coolers, the gas still holds tar in suspension in the form of minute globules called 'tar fog'. The removal of these last traces is accomplished by means of a P. & A. tar-extractor, which consists of a series of perforated steel plates, so arranged that the gas passing through the first plate will impinge upon the unperforated part of the second plate. The impact causes the very fine particles to coalesce and run down the plate.

duced at the rate of eight gallons per ton of coal.

The liquor, which contains about one-fifth the total ammonia produced, is treated in a continuous still where the ammoniacal vapors are liberated. These vapors are also passed through the saturator, which is so constructed that the waste gases that accompany the ammonia vapor from the still may pass into the main gas-stream, leaving the saturator, or to be conducted into the atmosphere.

The free leg of the ammonia still is made up of three 21-in. cast-iron sections and one 15-in. section, all resting upon the liming-chamber, which is 6 ft. high. The internal diameter of all sections is 4 ft. 3 in. and the total height of the free leg is 15 ft. The fixed leg is made up of two 21-in. sections and one 15-in. section of the same diameter as those comprising the free leg. Each section is provided with a vapor-passage through the bottom, covered with serrated edges, and an internal overflow for liquor passing to the next lower section.

Each section is provided with hand-holes by means of which access can be had to every part of the interior so that the apparatus may be readily inspected and cleaned.

The liquor enters the top of the still and drops from section to section; the steam which enters at the bottom, as well as any liberated vapors, pass through the vapor passages and bubble through the liquor at the edge of the hood. The boiling liquor from which the free ammonia has been expelled, is mixed with milk-of-lime in the liming-chamber and caused to flow into the fixed leg where the remaining ammonia is liberated. The escaping liquor contains 0.033% to 0.007% ammonia.

The saturator is provided with a heater for the mother-liquor; this may be used to maintain the temperature of the bath in case the still is not running or to heat the bath when starting a saturator. Under normal working conditions, the heat of the ammonia vapors from the still and the heat of dilution of the sulphuric acid, are sufficient to maintain a temperature of 45 to 50°C. The salt produced averages more than 20 lb. per ton of coal, and contains at least 25% ammonia and less than 0.2 of 1% free acid.

From the saturator the gas passes into the final coolers, which are 40 ft. high and 10 ft. diam., and are of the direct-contact type. The water not only cools the gas but mechanically washes out much of the naphthalene.

To recover the light oils, the gas is scrubbed with straw-oil, a petroleum product, in the hurdle washer 75 ft. high and 14 ft. diam. The slats composing the hurdles are 5 in. wide, $\frac{3}{4}$ in. thick, and spaced $\frac{3}{4}$ in. apart; thus the gas in passing through the scrubbers flows in thin streams over surfaces that are continually wet with the absorbent. The travel of the gas and oil is counter-current. The oil is pumped to the top of the scrubber and flows zig-zag down over the hurdles, while the gas enters at the bottom and leaves at the top; thus the partly de-benzolized gas is brought in contact with the fresh wash-oil, which is able more efficiently to remove the small amount of light oil yet remaining and likewise the partly benzolized oil is brought in contact with the rich gas and its light contact-oil increased. The amount of wash-oil circulated depends upon the number of cubic feet of gas produced and its light-oil content, and is of such an amount as to keep the light-oil content of the benzolized wash-oil between 2 and 3%. The benzolized oil is stored in a 3000-gal. tank, from which it is pumped to the stripping-still.

The de-benzolized oil leaves the still at about 130°C., and, before it is re-circulated, its temperature is reduced by a system of heat exchangers and coolers to about 20°C. The de-benzolized wash-oil leaving the bottom of the still and the light-oil vapors leaving the top of the still each contain a considerable amount of heat, which is transferred to the incoming benzolized oil. The benzolized wash-oil is pumped to the vapor-oil heat-exchanger.

From the vapor-oil exchanger, the partly heated benzolized oil joins the oil to oil heat-exchanger, where its temperature is increased by the de-benzolized oil leaving the still. After leaving the oil to oil heat-exchanger, the benzolized wash-oil enters a superheater where its temperature is raised to 140 to 150°C. This superheater furnished by the Alberger Heater Co. of Buffalo, New York, is 8 ft. long and about 20 in. diameter.

The hot benzolized oil now enters a stripping-still which is continuous in its operation. The still is made up of seven sections, each section being 12 $\frac{3}{4}$ in. high and 4 ft. 4 in. diam. The hot oil enters the eight sections from the bottom and passes down the still rapidly, giving up the light oil it contains. Steam is admitted in the bottom section and passes through the still, bubbling under the sealing bells of each tray and carrying upward the light oil in the form of vapor.

As noted before, the de-benzolized oil, on leaving the still, passes through the oil-exchangers, where it gives up some of its heat to the incoming benzolized oil, then to the wash-oil coolers, of which there are two, a tank-cooler containing two $\frac{1}{2}$ -in. steel pipes 22 ft. long, and a spray-cooler consisting of sixty 2-in. steel pipes 9 ft. long. From the cooler the oil goes to the de-benzolized-oil tank and is now ready for re-circulation.

From the 23,000-gal. light-oil storage-tank, the light oil is pumped into the crude-oil still, which consists of a horizontal cylindrical kettle holding 3800 gal. and a fractionating column of 14 sections resting on a separate foundation. Heat is supplied by means of indirect steam through sixteen 1 $\frac{1}{2}$ -in. extra-heavy pipes 13 ft. 10 in. long, placed in the bottom of the kettle so that the direct steam may be used when desired. The presence of live steam lowers the boiling-point and is necessary when the toluol and solvent fractions are reached.

The operation of the raw-oil still depends upon whether motor-fuel or pure products are to be produced. The first portion to distill is often discarded because of the carbon bisulphide it contains. When making pure products the crude distillate is divided into 90 benzol, 90 toluol, and solvent naphtha.

These crude products are then transferred to a lead-lined agitator where they are washed with sulphuric acid for about thirty minutes, after which about another thirty minutes is allowed for the used acid to settle. The acid is used to separate the unsaturated hydro-carbons, principally olefines. After the sludge is run off the benzol or toluol is washed with water and any acid remaining neutralized with caustic soda.

The washed products are now ready for rectification in the pure-oil still. This is similar to the crude-oil still in construction but greater care and skill is required in its operation. Each 1000 gal. of light oil will produce about 500 gal. C.P. benzol, 100 gal. C.P. toluol, and 100 gal. refined solvent naphtha. When making motor-fuel, the benzol, toluol, and such higher portions as will give a finished product that will distill to complete dryness at not over 135°C. are caught in the same receiver. After the crude motor-fuel has been run off, there still remains a solvent naphtha fraction, boiling at from 130° to 170°C. The crude motor-fuel is also washed with sulphuric acid, but not so thoroughly as in the case of pure products. This washed motor-fuel is then run through the pure-oil still in order to remove the last traces of water and any foreign substances that do not settle after washing. The products made are coke, gas, tar, ammonium sulphate, benzol, toluol, solvent naphtha, and naphthalene.

Chloride Roasting and Leaching at the Plant of the Tintic Milling Company

By THEODORE P. HOLT

The plant is situated in the Tintic mining district, about 100 miles south of Salt Lake City, Utah. It is controlled by Jesse Knight and was built originally to treat the low-grade ores of the Knight mines. This mill, being on the Eureka Hill, Denver & Rio Grande, and Los An-

The ore coming to the mill is weighed on standard railroad-scales and dumped into one of nine receiving-bins. These are hopper-bottomed, each having a steel-apron feeder which delivers the ore to a 24-in. belt-conveyor. This discharges over a 2-in. grizzly to a No. 2 gyratory crusher and through three sets of 16 by 36-in. rolls. The ore, reduced to $\frac{1}{4}$ in., is next elevated to the sampler. The samplers are of the Vezin type, designed to give a two-hundredth cut. After sampling, the ore is delivered to one of six storage-bins by a tripper-conveyor. Three of the bins are for sulphide ore and three for oxide. In addition, there are bins for salt and coal-dust.

Each bin is served by a variable-speed belt feeder. By proper regulation of the feeders a suitable admixture of oxide and sulphide ore is obtained, with about 9% salt and 2% coal-dust. This passes through 16 by 36-in. finishing-rolls, which gives a final 6-mesh



THE TINTIC MOUNTAINS, LOOKING UP FROM THE MILL

geles & Salt Lake railroads, is in a position to serve all the mines of the district, and at the present time receives ore from some twenty different properties.

Construction of the mill was started in the summer of 1915, and the plant began to operate in the following February. Owing to the use at first of a down-draft furnace, which gave unsatisfactory results, the plant treated only a small tonnage until the following year. It has now milled more than 250,000 tons and has demonstrated the profitable treatment of refractory low-grade ores. Earlier descriptions of the mill will be found in the technical press,* the present description of the improved plant will be readily understood by reference to the accompanying flow-sheet. See Fig. 1. The ores of Tintic vary widely in character. In general, they have a hard, silicious gangue with silver as the principal metal, together with some gold, copper, and lead.

*Trans. A. I. M. E., Vol. 49, p. 183; 'M. & S. P.', Aug. 29, 1914; and 'E. & M. J.', Feb. 6 and 13, 1915.



YARD, TRACKS, AND COVERED ORE-BIN AT THE MILL

product. A shuttle-conveyor distributes the ore to a long bin above the Holt-Dern roasters.

There are eleven roaster units, each chloridizing about 20 tons per day. The roasting is the vital operation in the process, since if the metals are properly chloridized they are quickly dissolved in the leaching operation. A pivoted-bucket carrier serves all the furnaces and elevates the roasted product to chutes, where it is sluiced

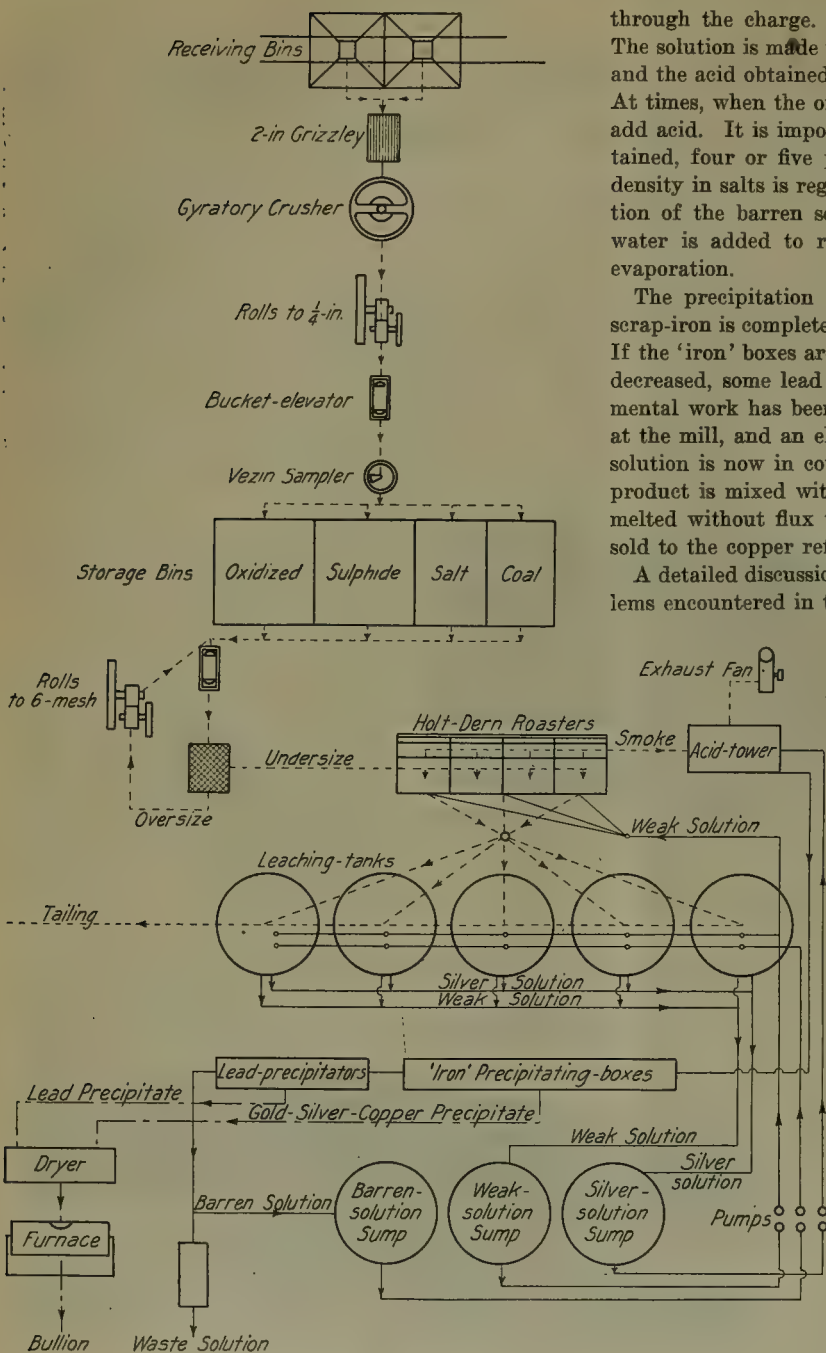


FIG. 1. FLOW-SHEET OF THE ROASTING AND LEACHING PLANT

through the charge. The leaching operation is simple. The solution is made up of the soluble salts in the calcine and the acid obtained from the smoke from the furnaces. At times, when the ore is high in lime, it is necessary to add acid. It is important that a slight acidity be maintained, four or five pounds per ton being ample. The density in salts is regulated by wasting a certain proportion of the barren solution each day. Sufficient wash-water is added to replace that discarded and lost by evaporation.

The precipitation of the gold, silver, and copper on scrap-iron is complete before any of the lead comes down. If the 'iron' boxes are too long, or the rapidity of flow is decreased, some lead is deposited. Considerable experimental work has been done on the precipitation of lead at the mill, and an electrolytic plant to handle the mill-solution is now in course of construction. The iron-box product is mixed with a small amount of coal-dust and melted without flux to a copper-silver bullion, which is sold to the copper refinery.

A detailed discussion of the various metallurgical problems encountered in the operations of the mill is outside the scope of this article. Some reactions that work beautifully in the laboratory have been found impossible of duplication in the mill. For example, mill-solution carrying a little free chlorine gave a good extraction of the gold when carried out in the laboratory. In the mill the results were erratic and the control of the gas proved a serious matter. Since the gold present in the low-grade ore is usually less than \$1 per ton and about 35% of this is recovered in the regular treatment, it is obvious that any practicable scheme must operate at a low cost. After three years of experimental work, it was determined to sluice the tailing to a separate plant and to treat it with a lime-wash, followed by cyanidation. The consumption of both lime and cyanide was much lower than would be expected. However, meanwhile the advance in the silver market has made it possible, for the present, to refuse

with mill-solution to the leaching-tanks. The original plan was to charge the tanks with dry ore, but sluicing is preferable for several reasons. The more important are the elimination of dust and the effective heating of the mill-solutions.

There are 12 leaching-tanks, 20 ft. diam. by 11 ft. deep. The porous character of the roasted product is such that no difficulty is experienced in getting the solution

all shipments of ore containing much gold, so that the erection of the cyanide annex has been postponed.

The presence of lime is objectionable, not only on account of the acid consumed, but because of its active de-chloridizing action in the roast. This action is well shown in the graph, Fig. 2. To guard against 'high-lime' ores, a penalty of 30 cents per unit is charged on all lime in excess of 3% contained in the ore. This figure

is obtained from the analysis for CO_2 , the result being calculated in terms of CaCO_3 . Sulphide ore is at a premium in the Tintic district, and to encourage the

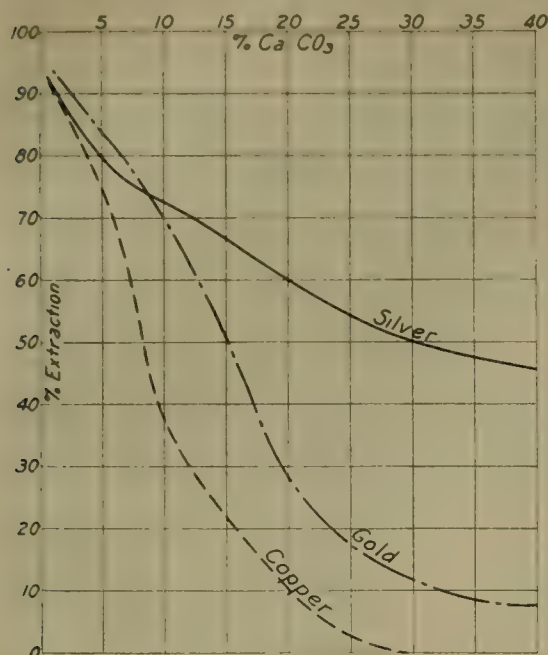


FIG. 2. GRAPH SHOWING THE EFFECT OF LIME ON THE EXTRACTION

shipment of low-grade sulphide the mill allows a credit on all the sulphur in ore containing 6% or more.

The Rakha Hills Mines

At present copper is being mined by only one company in India, the Cape Copper Co., whose Indian property—the Rakha Hills mines—has now reached a stage at which it seems practically assured of success. Some 45 years ago copper ore was mined by the Nerbudda Coal & Iron Co., and a certain quantity of ore was shipped to England; but the lodes were not large enough, nor sufficiently persistent, to justify a continuance of operations, and the mine was ultimately abandoned. It is interesting to note, however, that several of the early samples yielded from 12.6 to 47.8% copper, the average being 28%. At Rakha Hills there are no rich lodes like this, nor is such high content necessary to maintain successful operations. But a big body of copper ore has been proved and, worked by modern methods, there is little doubt that it will turn out to be of commercial importance. The property, which was formerly known as the Rajdoha, is situated in the Singhbhum district of Bengal, Chota Nagpur. The Cape Copper Co. exercised its option to acquire the property in March 1913, the idea being that it would perhaps make good the diminishing output from the famous O'okiep mine in Cape Colony. Excellent progress was reported up to the time the War broke out, the equipment of the mine being then within a few months of completion; and at the main shaft about 250,000 tons of ore, containing

something like 10,000 tons of copper and some gold, was actually opened up. Then came the War, which upset all plans. If the mine had only been producing copper at the time everything would have been well. The company would have been unaffected by the high freight-rates then ruling, because its supply of fuel is obtained in India, within quite a reasonable distance, and the market for its product is also local; it would also have had the benefit of high prices for copper. As it was, however, one obstacle after another arose, the completion of the plant was delayed, and work at the mine had practically to be brought to a standstill, because the company could not stand a continual drain upon its resources. In December 1918, however, the converter-plant started work, and in July 1919 the refinery-furnace was completed and put in operation. For several months the company has been producing and selling refined copper; and in this connection it is noteworthy that higher prices are obtainable for copper in the Indian market than in England, owing to the 7½% Indian import duty and the cost of freightage to Great Britain. At the annual meeting in December last, T. Blair Reynolds, the chairman, said that the company was now freed from the drain of remittances which, at an increasingly adverse rate of exchange, were necessary in order to keep the establishment going through the slow process, during the War, of erecting the refining plant. Mr. Reynolds added that he did not expect that the estimates on which Rakha was laid out would be realized at once—there were dislocations, he said, in India as elsewhere, and it would take time to get into normal running. The ore-reserves actually opened up and ready for extraction are now stated to amount to 384,294 tons, carrying 3.76% copper, which is equivalent to about 14,500 tons of copper, the average width of the lode being 3 ft. 6 inches.

SOME interesting discoveries have been made by British investigators in connection with mine-rescue apparatus. The apparatus is supplied with oxygen to make up for the foulness of the atmosphere through which the rescuer moves in a mine where there has been an explosion. Experiments with the rescue apparatus indicate that the extra supply of oxygen will enable the average man to walk faster and with greater comfort than is possible in the open air, even without the weight of the apparatus. Trials made with miners, however, bring out the unexpected fact that men who were accustomed to the atmosphere of mines do not find the same benefit. It is thought that their lungs have become adapted, through years of hard physical labor, to make fuller use of the oxygen in the atmosphere and therefore additional oxygen is not so helpful.

A PLATINUM determination is a difficult one for an assayer to make with his regular equipment. Samples of material in which the presence of platinum is suspected should be sent to a reliable chemist who is accustomed to such work. Many ores which have been reported as platiniferous by local assayers, have proved barren after the material was analyzed by more elaborate methods.

The Swansea Mill

By F. Le Roi THURMOND

The Swansea mine is located at Swansea, Arizona, 28 miles north of Bouse, a station on the Phoenix cut-off of the Santa Fe system. A standard-gauge railroad, the Arizona and Swansea, extends from Bouse to Swansea. An old smelter with blast and reverberatory furnaces testifies to the 'romance' of mining, a quality which seems to have greatly encumbered this property in the past. The mine and mill are operated by the Swansea Lease Incorporated. Jack Bruce is superintendent of the mine and Lyman F. Barber of the mill.

The ore is chalcopyrite in a gangue consisting mostly of specular hematite with small amounts of pyrite, chlorite, calcite, kaolin, quartz, and talc. The specular iron is very soft and friable and much of it can be broken in the hand. Chalcopyrite is associated with it. The chlorite, calcite, kaolin, and talc come from masses of unreplaced country-rock enclosed in the ore, and from portions of wall-rock which become mixed with the ore.

The ore from the mine is dumped onto a 4 by 8-ft. flat grizzly, with bars spaced $2\frac{1}{2}$ in., set over a 1000-ton bin. All but about 10% of the ore falls through the grizzly. The oversize is put through a 12 by 16-in. Blake crusher. From the bin the ore is fed with a steel conveyor-feeder onto a belt-conveyor, which discharges into the scoop-feed of a ball-mill. The ball-mill is 6 by 6 ft. made by the Allis-Chalmers company and operated by a 90-hp. motor through a short-centre belt-drive at 26 r.p.m. Two-inch chrome-steel balls are used. The discharge from the ball-mill goes to a No. 3C Dorr Duplex classifier, which returns the oversize to the mill. The overflow goes to a Minerals Separation flotation machine of 16 cells, driven by a 55-hp. motor. The shaft makes 390 r.p.m. The impeller-shafts are geared down in the ratio of $1\frac{1}{2}$:1, giving a peripheral speed of 812 ft. per minute.

Base oil is fed with the ore to the ball-mill, in the amount of $1\frac{1}{8}$ lb. per ton of feed. The oil is P. & E. No. 1, sold by the Gilmore K. & K. Oil Co. of Los Angeles. A mixture of No. 5 and No. 8 pine-oils in the ratio of 40:60, furnished by General Naval Stores Co., is fed to the classifier return, in the amount of $\frac{1}{4}$ lb. per ton of original feed. Trona, a natural sodium sesqui-carbonate from Searles lake, is used as a flocculating agent. It is charged into the bin with the ore in amounts varying from 8 to 12 lb. per ton of ore.

The pulp going to the flotation machine has a dilution of $2\frac{1}{2}$:1, the feed being split between the second and fourth cells. The froth from the second to sixth cells, inclusive, is a finished product and is elevated to a Dorr thickener that feeds an Oliver filter. The cake from the filter goes directly to the shipping-bin. Froth from the 7th to 16th cells is returned to the first cell for cleaning and constitutes the entire feed to that cell. Froth from this cell joins that from the primary cells as it goes to the thickener. The tailing from the flotation machine goes to waste.

Samples are cut from classifier overflow and from the

concentrate and tailing launders every 15 minutes. The copper content of the mill-heading during the month of January, averaged 2.3%; tailing averaged 0.05%, giving an extraction of approximately 98%. Notable as this result is, it has been exceeded for weekly periods and by individual operators, one man making 98.9% extraction for a week, and all operators for 24 consecutive shifts making a tailing of less than 0.01% with a concentrate assaying 24% copper. The figures for the month of January 1920, are tabulated below:

Tons milled	7800
Heading assay, % Cu.....	2.30
Tailing assay, % Cu.....	0.05
Concentrate assay, % Cu.....	22.54
Extraction, %	97.80
Oil used per ton, lb.....	0.75
Total cost per ton.....	\$0.95

The cost per ton has not been itemized but covers everything including crushing and loading the concentrate into cars. The concentrate is shipped to the Consolidated Arizona Smelting Co. at Humboldt, Arizona. An average assay of the concentrate is as follows:

	%		%
Cu	22.25	CaO	2.00
Fe	30.00	Zn	Trace
SiO ₂	2.50	Au	None
Insoluble	2.40	Ag	0.40 oz.
S	29.00		

Fluctuations in the character of the ore, in the amount of trona, and in the speed of the flotation machine are responsible for variations in results. Some of the ore shows incipient oxidation, and this causes a loss both of oxide and oxide-coated sulphide particles but deeper mining should eliminate this difficulty. Even better results are expected in future operations.

ACTIVE WORK was begun in December on the iron mines of Las Truchas property in Michoacán. 10,000,000 tons of ore is calculated as the minimum amount recoverable from the deposit. The company expects to reach an output of 5000 tons per day. Plans already proposed include the building of a standard-gauge railroad from the pit-mouths to the sea, and the construction of a harbor for the shipment of the ore. Since this shipping point is on the open sea, the improvements contemplated will require, perhaps, two years of dredging work, the construction of a breakwater, and either wharves or a quay, with at least 32 ft. of water at the berths.

CANADA has been the world's third largest producer of platinum during the last three decades. As most of the Canadian supply is obtained from the refining of blister-copper from the Sudbury mines, this portion of the production has not been credited to Canada, but chiefly to the United States, where the process of refining has been largely carried on. Native platinum has been found in various parts of western Canada, chiefly in the Tulameen district of the Similkameen mining division, from which, during the years 1887-1891, an average annual output of 1500 oz. was recorded.

The Friction of Ventilating Currents

By WALTER S. WEEKS

INTRODUCTION. The proper ventilation of metal mines is recognized today as an economic necessity. Ventilation is an old story to the coal-mining engineer, but it is either a new or a long-forgotten question to the metal-mining engineer. My purpose is to lay before the busy engineer the salient points of the subject, in the hope that ventilation projects may be worked out upon sound principles and in the hope that accurate data may be gathered to piece out our present meagre information. I shall deal entirely with mechanical ventilation.

Let us start with the simple problem of driving air through a tunnel that passes entirely through a hill. See Fig. 1. When air flows through such a passage, friction on the top, bottom, and sides of the tunnel retards the air so that an appreciable pressure must be maintained at the entrance to keep the air moving. The entire surface against which the air rubs is called the rubbing surface and is denoted by S . It is measured in square feet and is obtained by multiplying the perimeter of the section by the length of the tunnel.

It has been found that the resistance to flow varies with the square of the velocity. It has also been found that the resistance varies directly with the density of the air. It has also been found that the resistance varies with the character of the rubbing surface. Thus we see that the resistance to flow is a function of a number of variables.

If we denote the velocity in feet per minute by V , the density in pounds per cubic foot by d , and take into consideration the effect of the character of the walls by a constant, C , the resistance to flow may be thus expressed:

$$R = C d S V^2$$

R is the resistance measured in pounds.

The factor d varies so little in comparison with the other factors, that a standard weight of air is assumed and d and C are combined to make the familiar constant K . So the usual form of the equation is

$$R = K S V^2$$

Some treatises on ventilation say that K is measured in pounds per square foot, while others say that it is measured in pounds. K is not measured in any units. It is a constant that takes care of all the factors not denoted by symbols in the equation. The bewildering mass of contrary statements in the literature makes a simple subject appear abstruse.

From this fundamental formula the other formulas that deal with the friction of the air are derived.

The problem of moving air is the problem of pumping water through a horizontal pipe. We have to deal only with frictional resistance and velocity changes. For the present we shall consider friction alone.

Now let us suppose that we have connected to the entrance of the tunnel a large compressor with a fric-

tionless piston of exactly the same size as the tunnel. If we run this compressor with a piston speed of V , the air in the tunnel will flow with a velocity V . In order to run the compressor we must exert a thrust on the piston equal to R , which is the frictional resistance in pounds.

If the area of the piston is A square feet, the unit-pressure on the piston is $\frac{R}{A} = \frac{K S V^2}{A}$. This unit-pressure is denoted by p and is measured in pounds per square foot. It is the drop in pressure in pounds per square foot undergone by the air in passing through the tunnel.

THE AIR-PRESSURE. We should measure this pressure with a water-gauge. A water-gauge is a U tube of glass with water in it. The gauge would be placed outside the tunnel and one leg would be connected by a rubber tube to the inside of the tunnel at the entrance. The difference in level of the water in the two legs would indicate the difference in pressure between the air at the entrance of the tunnel and the atmosphere. This pressure would be read in inches of water, but it can be converted into any unit of pressure.

Suppose we have a cube of water measuring $1 \times 1 \times 1$ ft. This cubic foot of water would weigh about 62.3 lb., and hence there would be a pressure on the base of the tube of 62.3 lb. per square foot. If we divide the cube into 12 horizontal sections it will be seen that each section exerts $\frac{62.3}{12} = 5.2$ lb. per square foot. So if we denote the water-gauge in inches by i we have the useful relation

$$p = 5.2 i$$

p , as it will be remembered, is the unit-pressure in pounds per square foot.

The next question that interests us is: how much power is required to circulate the air?

Work = Force \times Distance.

Work per minute divided by 33,000 is horse-power.

The distance per minute that the piston of the compressor moves is V feet, so the work per minute that is necessary to move the piston is $p \times A \times V$.

$p \times A$ is the force on the piston.

But $A \times V = Q$, or the quantity of air flowing per minute.

Consider an opening of A square feet. If a column of air flows through the opening with a velocity of V feet per minute, in one minute the amount that will have passed through is $A \times V$, or Q .

So in any drift or tunnel where the drop in pressure is p pounds per square foot and the quantity of air in circulation is Q cubic feet per minute, the work per minute is $p Q$, and the horse-power is $\frac{p Q}{33,000}$. This value is often spoken of as the horse-power 'in the air'. It would

be the actual power of the motor necessary to overcome friction if our fan and motor were 100% efficient.

If we were dealing with a drift in a mine, instead of a tunnel, it would be less easy to measure the resistance, but if the drift were the same size and length as the tunnel, the amount of the resistance would be the same. In some way we should have to connect one leg of the water-gauge to the entrance of the drift and the other leg to the end of the drift. The difference in level of the water in the two legs would indicate the drop in pressure in the drift. The problem of measuring p in the case of

From this equation the following relationship can be deduced:

$$\frac{Q_1}{Q_1 + Q_2} = A_1 \sqrt{\frac{A_1}{K S_1}} \div \left(A_1 \sqrt{\frac{A_1}{K S_1}} + A_2 \sqrt{\frac{A_2}{K S_2}} \right)$$

To the expression $A \sqrt{\frac{A}{K S}}$ is given the name of 'pressure potential' of the split.

The law of natural splitting, then, may be stated thus: The quantity of air flowing per minute in a given split is to the total quantity flowing in all the splits starting at

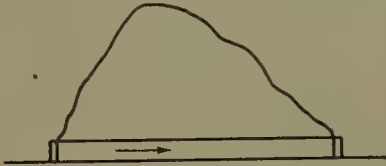


FIG. 1 Section

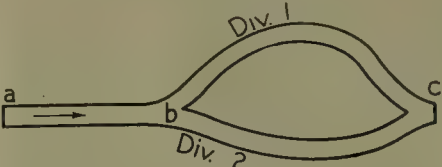


FIG. 2 Plan

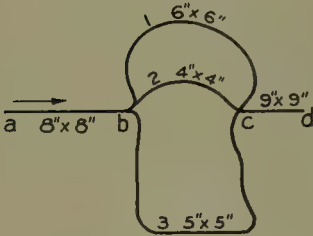


FIG. 3 Plan

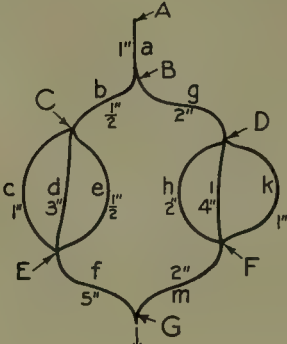


FIG. 4 Plan

the tunnel was simple because the end of the tunnel was at atmospheric pressure.

SPLITTING THE AIR. Let us now suppose that the tunnel is divided into two divisions inside of the hill, as shown in Fig. 2. a is one portal and c is the other. A fan situated at a is forcing Q cubic feet per minute into the tunnel. How much air will flow in division No. 1 and how much in division No. 2? This is the problem of the natural splitting of air.

Where a current of air is divided into several branches, these branches are called 'splits'. Natural splitting means the division of the air current without the introduction of regulators in the air-ways to control the flow. The pressure at b is the pressure at the beginning of both splits and the pressure at c is the pressure at the end of both splits; hence the drop in pressure in each split must be the same.

We have shown that the drop in pressure p in any air-way is $\frac{K S V^2}{A}$. If we designate the drifts by subscripts, 1 for division No. 1, and 2 for division No. 2, then

$$\frac{K S_1 V_1^2}{A_1} = \frac{K S_2 V_2^2}{A_2}$$

the same point and ending at the same point, as the pressure potential of the given split is to the sum of the pressure potentials of all the splits.

$$Q_1 + Q_2 = \text{total air flowing.}$$

The velocities of the air in the two splits will so adjust themselves that the drop in pressure in the one will equal the drop in pressure in the other.

The rule applies to any number of splits.

The derivation of the formula may be of interest. It is given on the next page.

CONTROLLED VENTILATION. Suppose we must meet the conditions illustrated by Fig. 3:

Air-way	Size	Length	Air desired
	Ft.	Ft.	per min. Cu. Ft.
$a-b$	8×8	1000	36,000
1	6×6	2000	18,000
2	4×4	1000	8,000
3	5×5	3000	10,000
$c-d$	9×9	500	36,000

We have here a fixed set of conditions. We wish a definite amount of air to flow in each drift. What will be the pressure that the fan must maintain at a , and how will the air be controlled?

The first operation is to calculate the drop in pressure from *b* to *c* in each split with the assigned amount of air. The split that has the greatest drop is called the 'free' split and will be left open. A difference in pressure equal to this drop must be maintained between *b* and *c* in order to force the required amount through the free split. But this difference in pressure will be greater than the calculated 'drops' in the other two splits, so the air in these splits will speed up to make the loss of pressure in these splits equal to the loss in the free split. This will give us more air than we need, so we must put restrictions in these splits in order that when the desired amount of air is flowing the drops in all three splits will be the same.

The total pressure on the mine is obtained by adding the drop in pressure from *c* to *d*, the drop in pressure in the free split, and the drop in pressure from *a* to *b*. The actual calculation will make this clearer, but we cannot

$$\frac{K S_1 V_1^2}{A_1} = \frac{K S_2 V_2^2}{A_2}$$

Take the square root of both sides

$$V_1 \sqrt{\frac{K S_1}{A_1}} = V_2 \sqrt{\frac{K S_2}{A_2}}$$

Multiply the left side by $\frac{A_1}{A_1}$ and the right side by $\frac{A_2}{A_2}$

$$A_1 V_1 \sqrt{\frac{K S_1}{A_1^3}} = A_2 V_2 \sqrt{\frac{K S_2}{A_2^3}}$$

Substituting Q_1 for $A_1 V_1$ and Q_2 for $A_2 V_2$

$$Q_1 \sqrt{\frac{K S_1}{A_1^3}} = Q_2 \sqrt{\frac{K S_2}{A_2^3}}$$

$$\frac{Q_1}{\sqrt{\frac{A_1^3}{K S_1}}} = \frac{Q_2}{\sqrt{\frac{A_2^3}{K S_2}}}$$

$$\frac{Q_1}{\sqrt{\frac{A_1^3}{K S_1}}} = \frac{Q_1 + Q_2}{\sqrt{\frac{A_1^3}{K S_1}} + \sqrt{\frac{A_2^3}{K S_2}}}$$

$$\frac{Q_1}{Q_1 + Q_2} = \frac{A_1 \sqrt{\frac{A_1}{K S_1}}}{A_1 \sqrt{\frac{A_1}{K S_1}} + A_2 \sqrt{\frac{A_2}{K S_2}}}$$

DERIVATION OF FORMULA

make any calculations until we have assigned a value to K .

DETERMINATION OF K .

$$K = \frac{p a}{S V^2}$$

If we take a given length of drift of uniform section

and measure the velocity of the air flowing and the drop in pressure undergone by the air in this length, these quantities, with the rubbing surface, will enable us to evaluate K . Such experiments have been made.

The value of K varies with the character of the rubbing surface. In drifts with smooth walls it is lower than in drifts with rough walls. Many investigations indicate that the shape and size of the section of the drift influence the value of K .

The time-honored value of K is known as the Atkinson coefficient and its value is 0.0000000217. This value is too high for the average drift. T. W. Fitch, Jr., before the West Virginia Coal Mining Institute in June 1910, gave the following values:

0.000,000,003,6 for air-passages that are concreted, wood-lined, or of exceptional smoothness, and untimbered, straight, regular, and free from obstructions.

0.000,000,007,3 for air-passages that are untimbered, fairly smooth, straight, unobstructed, and regular in size.

0.000,000,010,9 for air-passages that are untimbered and moderately crooked, irregular, obstructed, and rough.

0.000,000,014,6 for air-passages that are timbered, but otherwise fairly smooth, straight, unobstructed, and regular in size.

0.000,000,018,2 for air-passages that are timbered and moderately crooked, irregular, obstructed, and rough.

0.000,000,021,9 for air-passages that are timbered, and very crooked, irregular, and rough.

The value of K may be still higher than the last given in cases of air-ways in extremely bad condition.

F. Ernest Brackett, in an article in the 'Engineering and Mining Journal', April 22, 1911, entitled 'Friction of Air in Mines', has prepared a workable table of values of K in such a way that the shape and size of the section are given weight.

It is evident that the validity of such calculations depends upon the selection of the proper values of K . The determination of K for the types of openings found in metal mines is an investigation that should be undertaken.

We shall now calculate the problem in controlled ventilation, using the Atkinson value of K .

Drift No. 1.

$$p = \frac{K S V^2}{A}$$

$$S = 24 \times 2000 = 48,000.$$

$$V = \frac{Q}{A} = \frac{18,000}{36} = 500.$$

$$p = \frac{0.0000000217 \times 48,000 \times 250,000}{36}$$

$$p = 7.23 \text{ lb. per square foot.}$$

Drift No. 2.

$$p = \frac{K S V^2}{A}$$

$$S = 16 \times 1000 = 16,000.$$

$$V = \frac{8000}{16} = 500.$$

$$p = \frac{0.0000000217 \times 16,000 \times 250,000}{16}$$

$$p = 5.43 \text{ lb. per square foot.}$$

Drift No. 3.

$$p = \frac{K S V^2}{A}$$

$$S = 20 \times 3000 = 60,000.$$

$$V = \frac{10,000}{25} = 400.$$

$$p = \frac{0.0000000217 \times 60,000 \times 160,000}{25}$$

$$p = 8.33 \text{ lb. per square foot.}$$

Drift No. 3 will be the free split, and doors with adjustable apertures must be placed in No. 1 and No. 2 to increase their resistance. These apertures must be adjusted until the correct amount of air is flowing.

The difference in pressure between point *b* and point *c* will be 8.33 lb. per square foot.

The amount of pressure that we must waste in the regulator in drift No. 1 is

$$8.33 - 7.23 = 1.1 \text{ lb. per square foot.}$$

The amount we must waste in the regulator of drift No. 2 is

$$8.33 - 5.43 = 2.90 \text{ lb. per square foot.}$$

Drift *a-b*.

$$p = \frac{K S V^2}{A}$$

$$S = 32 \times 1000 = 32,000.$$

$$V = \frac{36,000}{64} = 562.5.$$

$$p = \frac{0.0000000217 \times 32,000 \times 31,640.6}{64}$$

$$p = 3.43 \text{ lb. per square foot.}$$

Drift *c-d*.

$$p = \frac{K S V^2}{A}$$

$$S = 36 \times 500 = 18,000.$$

$$V = \frac{36,000}{81} = 444.4.$$

$$p = \frac{0.0000000217 \times 18,000 \times 197,491}{81}$$

$$p = 0.95 \text{ lb. per square foot.}$$

The total pressure that must be maintained by the fan to overcome friction is then

$$3.43 + 8.33 + 0.95 = 12.71 \text{ lb. per square foot.}$$

A water-gauge at the fan would read

$$\frac{12.71}{5.2} = 2.44 \text{ inches of water.}$$

The horse-power necessary to overcome friction is

$$\frac{12.71 \times 36,000}{33,000} = 13.9.$$

Assuming a 60% efficiency for fan and motor, the horse-power of the motor would be 23.2.

I have purposely neglected all discussion of velocity-heads because I think it will be easier to take up that subject after we have considered the centrifugal fan.

The ramified workings of a mine may not look like a group of splits at first sight, but with a little patience they may be grouped into primary splits. These primary splits may be made up of secondary splits, and so on. In a group of splits the free split is the only one that figures in determining the mine pressure, so we can

gradually work down to the single air-course that offers the greatest resistance and so determine the mine pressure. This is shown diagrammatically by Fig. 4. The capital letters indicate points and the small letters sections of drift between the points. A given amount of air is assigned to each section and the drop in pressure in inches of water is marked on each.

At the point *B* two primary splits begin and these are divided into the secondary groups *c d e* and *h i k*.

Let us look first at the secondary splits. Of the secondary splits on the left side, *d* has the greatest resistance and of those on the right *i* has the greatest resistance. The resistance of these free secondary splits will be used in determining the resistance of the primary splits.

The difference in pressure between *C* and *E* must be 3 inches.

The difference in pressure between *D* and *F* must be 4 inches.

Drop in pressure from *B* to *G*

$$\text{via } b d f = \frac{1}{2}'' + 3'' + 5'' = 8\frac{1}{2}''$$

$$\text{via } g i m = 2'' + 4'' + 2'' = 8''$$

Regulators may be placed as follows:

Left Side. *b*, *d*, and *f* will be open.

Regulator in *c* will waste 2 inches.

Regulator in *e* will waste 2½ inches.

Right Side. *i* and *m* will be open.

Regulator in *g* will waste ½ inch.

Regulator in *h* will waste 2 inches.

Regulator in *k* will waste 3 inches.

A water-gauge on a pressure-fan at *A* will read 9½ inches

In closing this discussion let us calculate a problem in the natural splitting of air. Referring to Fig. 2, let us suppose that division No. 1 is 1500 ft. long and its section is 5 × 7 ft. Let division No. 2 be 1000 ft. long and its section 8 × 8 feet.

The total air in circulation is 10,000 cu. ft. per minute. How much will flow in division No. 1 and how much in division No. 2.

$$\frac{Q_1}{Q_1 + Q_2} = \frac{a_1 \sqrt{\frac{a_1}{K S_1}}}{a_1 \sqrt{\frac{a_1}{K S_1}} + a_2 \sqrt{\frac{a_2}{K S_2}}}$$

If the *K* is the same in both drifts we may cancel it.

$$a_1 \sqrt{\frac{a_1}{S_1}} = 35 \sqrt{\frac{35}{36,000}} = 1.09$$

$$a_2 \sqrt{\frac{a_2}{S_2}} = 64 \sqrt{\frac{64}{32,000}} = 2.86$$

$$\frac{Q_1}{Q_1 + Q_2} = \frac{1.09}{1.09 + 2.86} = 0.276$$

Amount flowing through Div. 1 = 0.276 × 10,000 = 2760

Amount flowing through Div. 2 = 7240

Let it be clearly understood that we have dealt entirely with the pressure necessary to overcome the friction of the air in the mine. It may be necessary to supply additional pressure to increase air-velocities in the mine. I shall discuss this subject in a later paper.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

THE SHATTUCK-ARIZONA COMPANY IS DEVELOPING PROPERTY IN SONORA.

BISBEE.—The Irish Mag Leasing Co. is about to resume operations on the C. & A. lease of that name, under an agreement made by local people who will finance the undertaking.

It is announced by the Shattuck-Arizona company that

to 25 oz. silver with occasional high-grade pockets. These are to be developed.

KINGMAN.—Tony Hill, developer of several successful mines, has taken over the Gold Button mine in the Aubrey district and will commence development work immediately. Several shallow shafts have been sunk on the property.

MIAMI.—It is reported that the Van Dyke Copper Co.'s



INTERNATIONAL SMELTER AT MIAMI, ARIZONA

conditions in the Shattuck-Arizona mine are rapidly approaching normal following the flooding of the mine below the 700-ft. level to extinguish the fire of last year. The mine is now operating one 8-hour shift and approximately 300 tons per day of lead-copper ore is being mined. The Shattuck shaft is to be sunk 200 ft. and development is planned for the 1000 and 1200-ft. levels. An option to purchase the Con. Virginia property, a silver prospect situated in Sonora, Mexico, 125 miles south of the boundary, has been obtained. The property comprises 246 acres of mineral-bearing territory and is situated in the Sierra Madre mountains east of the town of Moctezuma. It is said to have a splendid surface showing and shallow prospect holes show ore which assays 5

shaft, which is being sunk to the east of the Miami fault, is now down 1210 ft. and has passed through 30 ft. of carbonate which has become high-grade shipping ore in the shaft bottom. It is stated that this ore is in Pinal schist under the Gila conglomerate and is the same ore as that passed through by the No. 1 drill-hole put down in the spring of 1917.

SUPERIOR.—Clearing ground for the new power-plant of the Queen Creek Copper Co. is well advanced. The machinery for the plant has been ordered and delivery is expected immediately. The present inclined shaft is down 800 ft. Rich copper and gold ore was opened on the 400-ft. level.

YUMA.—It is stated by W. J. Johnson, the owner of

the New King of Arizona property, that rich gold ore has been opened. Machinery is now being shipped to the mine to develop and mill the ore.

COLORADO

THE MINING SITUATION IN CRIPPLE CREEK.

CRIPPLE CREEK.—A. E. Carlton, president of the Golden Cycle Mining & Reduction Co., in a letter accompanying the April dividend checks, announces a reduction of the dividend rate to two cents, \$30,000 in place of \$45,000 commencing May 10. The Portland has cut its dividend from \$60,000 to \$45,000 monthly and the Vindicator company has passed its quarterly dividend and will conserve its treasury reserve to be used for development purposes. Discussing this action the letter says:

"Appreciating that many of the stockholders in our company were largely dependent upon the income from their investment, your directors have continued dividends on the basis of three cents per share monthly. As the earnings for some time past have not been sufficient to meet the dividend requirements, it was necessary to use reserves, largely accumulated by the sale of various investments and property of the company.

We have now reached a point where further dividends on the present basis would leave the company without sufficient working capital, and your directors have determined to reduce the dividend rate beginning May 10, to the basis of two cents per share monthly.

A large part of the Cripple Creek ore has been produced by lessees, who have been gradually forced to suspend until now, few, if any, are operating. Development work has not been possible, and the output continues to decrease. The Golden Cycle Mining & Reduction Co. owns approximately 40% of the United Gold Mines property, one of the most valuable in Cripple Creek. The company also owns some 3000 acres of coal land six miles north of Colorado Springs, containing 15,000,000 tons of developed coal, and now producing in excess of 200,000 tons per annum. The company also owns the Golden Cycle mill, with an ore capacity of 40,000 tons per month.

MAYDAY.—A number of prospects are being developed in the district and some ore is shipped regularly. Charles Morris, contracting on the Little La Plata, which is being operated under bond and lease by W. A. Becker, has driven 135 ft. of cross-cut. This work is being done to explore the Little La Plata at depth. No ore has yet been found. Charles Curtet and Joe Moigg, lessees on the Southern Boy, are driving a cross-cut to gain depth on an orebody exposed in a shaft where they have worked during the past eight months. After being practically closed down for two weeks, the Jumbo is again shipping. The Mayday, which has been idle for several years, will begin operations about May 1, with a force of 25 men, it is said.

LEADVILLE.—High-grade gold ore, contained in 50 sacks, with an estimated value of \$50,000, from the property of the Rex Mining Co., at the Ibex mine on Breece Hill, were brought to the city and placed in the vault of the Carbonate National Bank for safe keeping. The ore was mined by eight Austrians, operating under

lease. Since the discovery was made last February, the lessees have been shipping steadily, but the sacked ore is the richest taken out to date.

A new corporation, the Leadville Silver Mines Co., has secured control of the Emmett property in California gulch above the Yak tunnel, and holdings in Poverty flats. High-grade ore has been mined on the Emmett and the new company, organized by Florence N. Doty, S. P. McDonald, and George Bennett, well-known Leadville operators, plans extensive development. The new wage-scale of \$4.50 per day has gone into effect, and the shortage of miners has been relieved, as many men have returned to the district.

MICHIGAN

HANCOCK.—SENECA.—FRANKLIN.

HOUGHTON.—Operations at the Hancock property continue to be confined to the territory east of the main Pewabic lode. General physical conditions are improving. While the company is not operating as many drills and is therefore not able to carry forward its exploration program upon the scale anticipated, the results to date have been satisfactory. The showing on the No. 12 amygdaloid is encouraging. This lode was opened in a cross-cut from the 44th level. Drifts in both directions continue in mineralized ground which contains copper ore comparable to the general run of the Pewabic lode proper. Stopping ground will be opened from this level. The machines operating on No. 3 lode are in fair ground. Efforts to connote the geological tendencies of this broken area continue to offer serious problems. The identification of No. 15 conglomerate was positive, but aside from this recognized fact the other lodes are doubtful.

Seneca resumed sinking in the main shaft on April 10. The work is progressing rapidly and will permit early opening of the fourth level. The shaft now has attained a depth of 2100 ft. Resumption of the mining on the third level will start immediately. The cross-cut to the lode was through before the shaft-sinking was suspended to permit concreting. Drifts both north and south on the vein will be started immediately. The longitudinal work on the fourth level to tap the Kearsarge amygdaloid will not take long and then there will be two openings at that depth. It is planned to carry the shaft down to 2600 ft. rapidly. There will then be eight levels from which development may proceed. Diamond-drill work, carried on from surface, to find out just what ore the Calumet conglomerate, the Osceola amygdaloid, and the other lodes that traverse the property may contain has been concluded with the results stated. The diamond-drill work, which is being conducted in the Gratiot shaft, has not yet progressed to a point where there is assurance of ore. This work is going forward on the sixth level. Sinking the Gratiot shaft will be undertaken on May 1.

HANCOCK.—Progress in the 39th level drift in the Allouez conglomerate at the Franklin mine continues in ore that will produce 25 lb. per ton. The north drift now is in 400 ft. The rich material is found in true formation for a distance of 100 ft. For the first 250 ft. of the

north drift the character of the formation was not particularly encouraging. Beyond was good rock which has steadily improved in character. Going back in the drift the raises opened practically the same rich ore as that found farthest north. Continued development in these raises shows ore all the way along, proving that the north lateral, for the first 250 ft., was simply below grade. These raises continue in good ground and give further support to the expectation that this rich streak of copper

MINI.—New York interests have taken over the Lee Mountain property for further development. The mine is opened by a series of drift tunnels 850 ft. long by means of which a depth of 600 ft. has been obtained. The production record of the mine is conservatively placed at \$1,500,000.

BEAVERHEAD COUNTY.—The Argyle Silver Mining Co., operating in the Vipond district, hopes to begin operation by May 1. The Argyle shaft has been re-timbered, the



MAP OF WESTERN MONTANA

will be found to continue from the 30th to the 39th level. The south drift has been started in good-looking ground.

MONTANA

CONSTRUCTION STARTED ON THE NEW MILL OF THE BOSTON & MONTANA DEVELOPMENT CO.

PHILIPSBURG.—The regular producers in the Philipsburg district include the Granite Bi-Metallic, Scratch-all, Williams & Hickey, and the Dolan mines. The Bi-Metallic is shipping three to five cars of manganese, and four to five cars of silver ore daily. A shaft is being sunk on the True Fissure property; 500 miners are working in the district at present.

LUMP CREEK.—With the work of re-timbering of the Free Coinage shaft completed, sinking will be continued to a depth of 1000 feet.

hoisting machinery overhauled, and the mine workings cleaned up. J. Benton Leggat is president.

WHITEHALL.—The Jefferson Mines Co. reports the discovery of a high-grade orebody containing copper, gold, and silver on the Dorothy claim. A large area is held, including the Dorothy, Sunlight, and Lamplight claims. Ore on Clark's Fork is said to assay \$8 per ton, the shoot extending for a considerable distance. Denver capital is behind a new development scheme for the district.

EAST HELENA.—Four large furnaces are being operated at the A. S. & R. plant, 1000 tons of ore per day being smelted.

BUTTE.—The Anaconda company's production of copper for the month of March totaled 18,450,000 lb. The Boston & Montana Development Co. has started construction of a 500-ton mill and concentrator. The foundation is already in with the machinery and supplies on hand.

Two tunnels tapping the mine reach the principal veins at 400 ft. and 1200 ft. Several years supply of low-grade ore has been blocked out, and 150 men are employed on construction and development work.

NEIHART.—High-grade silver ore, in a vein 18 in. wide, is reported to have been opened on the Neihart Consolidated property while sinking the shaft.

NEVADA

LESSEES ON THE FLORENCE ARE MINING HIGH-GRADE ORE.

GOLDFIELD.—Two hundred tons of ore of an average value of \$100 per ton is being hoisted for shipment from the Cracker Jack lease on the Florence, according to official statements made by the Florence and Cracker Jack managements. Most of this ore has come from a short distance above the 358-ft. level, where there is a stope 35 ft. long in a shoot of erratic width and richness. Several mine carloads of ore assaying as high as \$500 per ton have been broken in this stope as a result of careful mining. This find was made in territory cut by numerous old workings and there is little chance for the shoot to produce a large tonnage. On the 400-ft. level, with conditions good for a persistent orebody, a shoot has been opened for a length of 50 ft. and for an equal depth by a winze. The drift and winze have shown the average width of the ore to be 18 in. and the average value \$100 per ton. The vein is from 1 to 4 ft. wide. At the north end of the drift there is 1 ft. of ore assaying \$416 and at the south end there is 3 ft. assaying \$300 and 8 in. assaying \$545. On the 500-ft. level a raise has been driven 50 ft. in ore assaying from \$28 to \$36 in gold and containing 4% copper. On the 165-ft. level of the old Rogers lease shaft a 3-ft. width of ore of an average value of \$380 has been opened. Eight working faces are being advanced in the lease. These finds are the result of prospecting since January 1. Hundreds of feet of development work has been done since then, consisting principally of cross-cuts and raises into the walls of stopes in a search for parallel shoots in the Consolidated-Florence vein. A number of other lessees are using machine drills and the bonanza levels in the vicinity of the former main productive territory should be exhausted by the first of next year. After making connection with a lease shaft for ventilation purposes the Florence company has resumed driving of the west cross-cut, now 1000 ft. long. At 725 ft. from the shaft a drift has been started in a vein in which ore was found years ago in the Moore lease.

MONTEZUMA.—The shaft of the Montezuma Silver Mines Corporation, at a depth of 303 ft., is in low-grade silver-lead ore, the assays from a width of 18 in. varying from \$15 to \$45. The shaft is damp, but there is no indication that the water-level is near. Drifts have been started east and west from the bottom of the shaft and a cross-cut will be driven into the foot-wall of the vein from one of them. While rich ore has been opened under exceptionally promising conditions, there is nothing exposed in the shaft at present to indicate that the company has more than an excellent prospect, with better than an average chance to open more ore in the foot-wall

of the vein and at greater depth. The greatest width of the vein occurred in the centre of the shaft, which at a number of places reaches the proportions of a stope. Ore still shows on the foot-wall side of the shaft, but practically all has been removed and on the east and west sides the vein nowhere has a width of more than two feet. Previous reports of an extreme width of 4½ ft. were made while the bottom of the shaft was in a bulge in the vein, which continued for only a short distance.

DIVIDE.—Ore 4 ft. wide, 3 ft. assaying \$85 and 1 ft. assaying \$330, has been found at a depth of 310 ft. in the Victory. The find was made in the main Tonopah-Divide vein, 240 ft. north-west of the shaft. The drift has been advanced 15 ft. in ore of similar grade and a cross-cut has been started to determine the width of the vein. The cross-cut being driven on the 400-ft., or bottom level, of the East Divide is near the objective of many months work, a vein striking north. This vein has a prominent outcrop on the claims of the East Divide. Conditions in the Alto continue promising, particularly in the north drift on the 400-ft. level, but an important orebody has not been found.

CACTUS.—The shaft of the Cactus Nevada is 270 ft. deep and a contract has been let for sinking an additional 100 ft. A station is being cut at the 265-ft. point and the cutting of the vein at this depth will be of importance, as it will determine whether there is an improvement in the broken condition of the vein found on the 165-ft. level.

WEST DIVIDE.—One and one-half feet of low-grade silver-lead ore has been entered in a drift being driven in the vein at a depth of 150 ft. in the West Divide, indicating that ore of good grade may be found when the drift has been advanced under where high-grade ore was found at a depth of 65 ft. in the shaft. Driving of the south drift from the shaft has been resumed and conditions are improving, although the ore still is in narrow seams.

MANHATTAN.—The vein in the White Caps is being prospected at a depth of 800 ft. Conditions are reported to be similar to those on the 600-ft. level and assays of from \$20 to \$25 in gold have been obtained. The ore contains stibnite, an antimony tri-sulphide containing gold; realgar, an arsenic mono-sulphide; and orpiment, an arsenic tri-sulphide. Arsenical ore is now being shipped from the sixth level.

SHOSHONE.—What is said to be a valuable deposit of kaolin is reported to be under investigation by the Standard Oil and Armour companies. The deposit is owned by O. L. Ray, prominent in Bullfrog and Jarbidge during the early days of those districts.

UTAH

COAL PRODUCTION.—NEW MILLING PLANT AT EUREKA.

SALT LAKE CITY.—The coal mines of the State, in spite of the slacking-up that usually comes with the advent of spring, are working at about 85% of normal capacity, according to John Crawford, coal mine inspector, who has just returned from a trip to Carbon county, the largest coal-mining district in Utah. The output of coal from Utah mines in January broke all records, while the

February production was almost as large, and did break the record so far as daily output is concerned. Labor conditions are satisfactory, and coal miners are making high wages.

A revision of the itinerary of Bureau of Mines car No. 11, which has spent the past six months in Utah, and is now at Battle Mountain, Nevada, has been announced as follows: At Battle Mountain until April 24; en route to Salmon, Idaho, April 25 to May 1; Salmon, May 2 to 8; Gilmore, May 9 to 15; Driggs, May 16 to 22; Mackay, May 23 to 29; Hailey, May 30 to June 5. R. V. Ageton, engineer in charge of the car, has gone to Houghton,

000 was paid during the year to Simon Bamberger for the 'Fortuna' group of claims, and the remaining \$25,000 will be paid on or before July 1, 1920. In his report, Mr. Ballantyne states that all of the company's efforts were devoted to the development of the mine through the main tunnel from the Bingham side, which is opening the property at depth. A total of 2267 ft. of such work was done. The revenue to the company from ore sales was \$72,000, which, with miscellaneous income, brought the gross income for the year up to \$74,284. Lessees shipped ore of a total value of \$9148. During the first six months of the year, the property was operated at a loss of \$10,661, while during the last months, an operating profit of \$26,531 was realized, making a net profit for the year of \$15,870 from mining operations. The company has a contract for the purchase of the Tiewaukee group of claims for \$37,500, which carries a penalty of \$10,000 per annum until the full consideration is paid.

EUREKA.—Three feet of ore, which averages better than \$50 per ton, was cut recently in a drift on the 800-ft. level at the Eureka Bullion property. When first entered the ore was from 12 to 18 in. wide and was found to be going almost straight down. A winze was started on the ore, and in a few feet it had widened to three feet, with indications that it was making from the fissure into the surrounding brecciated limestone.

Shipments from this district during the week ending April 10 increased to 173 carloads, as compared with 151 carloads for the previous week. The Chief Consolidated shipped 39 cars; Dragon, 29; Tintic Standard, 29; Iron Blossom, 16; Eagle & Blue Bell, 16; Colorado, 12; Gemini, 6; Grand Central, 6; Victoria, 5; Centennial-Eureka, 4; Bullion-Beck, 2; Mammoth, 2; Silver Peak, 1; Empire, 1; Tintic Mill, 1 car bullion; Gold Chain, 1; Sunbeam, 1; Swansea, 1; and Godiva, 1.

Just about a year ago work was begun in earnest at the property of the North Standard Mining Co. During this time the shaft has been sunk to a depth of 525 ft. and 1400 ft. of drifting and cross-cutting has been done. At present the face of the east drift to the north-south fissure is but a few feet from the intersection, according to the opinion of John M. Manson, general manager. The face of the west drift along the same break to another north-south fissure is now 155 ft. from the main drift. Work is being done in three faces. Samples from the east drift on the 500-ft. level assay 32 oz. silver and 19% lead.

C. C. Griggs, who recently returned here to construct a milling plant for the treatment of low-grade ores from the May Day and Uncle Sam mines, has secured a long-time lease on the entire upper workings of the Yankee Consolidated property, adjoining, which ensures an ample supply of ore for some years. Mr. Griggs has incorporated what will be known as the Griggs Huish Leasing Co., with a capitalization of \$125,000. It is proposed by the new company to completely overhaul and remodel the present milling plant of the May Day company. This plant has an ideal location, it being possible to tram the ore directly from the May Day, Yankee, and Uncle Sam mines. A small amount of work will be necessary to



MAP OF NEVADA

Michigan, to take charge of car No. 10. His successor has not been appointed, but in the meantime G. W. Grove will have charge of car No. 11.

BINGHAM.—The Montana Bingham Consolidated Mining Co. has issued a detailed statement covering the affairs of the company for the year 1919. At the annual meeting held recently in Salt Lake City, C. G. Ballantyne was re-elected president; E. A. Vail, vice-president; J. B. Mossman, secretary and treasurer; W. E. Hubbard, L. B. McCornick, Imer Pett, and John A. McCandless, additional directors. Since last September, the management of the mine has been in the hands of an executive committee consisting of Messrs. Ballantyne, Vail, and Pett. Announcement was made at the meeting that \$75,-

complete needed connections. The incorporators of the Griggs Huish Leasing Co. have arranged a profit-sharing feature for employees; not only those engaged in the operation of the mill, but in the mining and handling of ores. Under this arrangement, the employees will receive the earnings from 20% of the capital stock, and will also be entitled to representation on the Board.

The directors of the Iron Blossom Mining Co. on April 10 declared a dividend of $2\frac{1}{2}$ cents per share, payable on April 26. This will call for the payment of \$25,000. Another of the Knight properties, the Dragon Consolidated, will pay a dividend of 1 cent per share on April 26. This will call for the payment of \$18,750.

PARK CITY.—Shipments from this district for the week ending April 10 totaled 2182 tons, as compared with 2098 tons for the week ending April 3. Judge Mining & Smelting shipped 554 tons; Silver King Coalition, 523 tons; Ontario Silver, 609 tons; Daly-West, 333 tons; Daly, 108 tons; and Naildriver, 33 tons.

In the last hundred feet, the Spiro tunnel at the Silver King Consolidated has passed through two water-courses and entered mineralized ground. It is said that there is every indication that the bore is entering the fissured zone which strikes south-west from the old Consolidated workings and the Silver King Coalition, and the discovery of ore is now a possibility at any time. Usual progress is not being made, owing to the scarcity of miners. On April 1 the tunnel was 12,500 ft. from the portal and within 2500 ft. of the Comstock shaft.

ALTA.—Repairs have been made to the power-line serving the Emma mine so that pumping operations have been resumed and all danger of the mine being flooded has been passed, according to George Dern, general manager. Most of the power used by this property comes from the Utah Power & Light Co.'s plant in Big Cottonwood canyon, the power-line running over the mountain from the Cardiff mine. This line was carried away by the recent snowslide on the properties of the Sells and Wasatch mining companies. Immediately after the accident, the Emma company put a force of 20 men at work to make a temporary connection with the Wasatch Mines power-line. Before the necessary connection could be made, water filled the lower workings of the Emma to the 200-ft. level.

At the annual meeting of the stockholders of the Howell Mining Co., Thomas L. Walden was elected president and general manager; M. J. McGill, vice-president; Harry Deming, secretary and treasurer; James Burke and Thomas Paul, additional directors.

BRITISH COLUMBIA

NEW LITIGATION INVOLVING THE DOLLY VARDEN PROPERTY.

VANCOUVER.—The Federal Department of Justice has refused to disallow the Dolly Varden Mines Railway Act, 1919, passed at the last session of the Provincial legislature, by which the Dolly Varden mine was awarded to the Taylor Mining Co. subject to conditions, which previously have been discussed. Upon receiving this information from Ottawa the attorney for the Dolly Varden

Mines, Ltd., immediately issued two writs: one asks for a series of declarations setting aside the act and all proceedings taken under its provisions, and the other asks for damages for alleged trespass and for the payment to the plaintiff of all moneys realized from ores produced from the mine. The Taylor Engineering Co. and the Taylor Mining Co. are made defendants to both actions, while the incorporators of the Taylor Mining Co., A. J. Taylor, H. C. Chine, John Anderson, C. M. Rolston, J. F. Tener, and R. P. Buchart, are added to the defendants. Fortunately for the good of the Province and of the north-western district in particular, no injunction to prevent continuance of work has been asked. The Taylor Mining Co. had planned to increase its capital, for the purpose of erecting a modern concentrating plant at the mine, extending the railway, and adding to its equipment. It is possible that the suit may interfere with this plan for the present.

GRAND FORKS.—The Granby Consolidated M. S. & P. Co. has decided to completely close and dismantle the Phoenix mines and Grand Forks smelter. Any machinery that can be used at Anyox or Cassidy will be removed to one or other of those places and the rest will be offered for sale. According to the last report, there is still some 3,000,000 tons of low-grade ore in the Phoenix mines, and for some time the company has been considering the advisability of erecting a concentrating plant to treat this material. The ore, however, is of so low a grade that the enterprise would be a doubtful one with the copper market in its present state. The Canada Copper Corporation is advertising the sale of the Greenwood smelter. At one time the citizens of Greenwood thought of forming a syndicate to buy the smelter, so as to preserve the local industry, but this idea seems to have been abandoned. It looks as though the Boundary district is going to lose its smelting industry, which has been the mainstay of Greenwood and the surrounding neighborhood for more than 20 years.

ROSSLAND.—The whole of the surface buildings and plant of the White Bear mine was destroyed by fire on April 5. The property was purchased by the Consolidated M. & S. Co. some months ago, and the underground workings have been connected with those of the company's other Rossland mines, so the fire, though it entails a loss of about \$30,000, will not interfere with operations at the mine. Only development work is being done by the company in this district at the present time. Charles Hanson and W. H. Rhomberg have purchased the Crowned King group of claims, on Front creek, in the Nelson division. Some rich gold ore has been taken from the property.

STEWART.—The Pacific Coast Development Co. is carrying on development of the Big Missouri and is taking in supplies over the snow so that the possibility of transportation difficulties in the summer will be obviated. P. W. Racey has been appointed engineer in charge of the properties of the Silver Creek Mines, Ltd.

HAZELTON.—The opening of a new vein of two feet of good milling ore is reported by the operators of the Silver

Standard mine. Development is continuing. Necessary alterations and repairs have been made to the mill and operations have commenced, some silver-lead and silver-zinc concentrates already being ready for shipment. Because of this early start the milling season will be six weeks longer than usual.

KAMLOOPS.—A car of high-grade ore from the Joshua mine of the Donohue Mines Corporation awaits shipment to the Trail smelter. Additional concentrating machinery is to be put in to bring the capacity of the plant up to 25 tons per day.

YMER.—The Mining Corporation of Canada has taken up its bond on the Yankee Girl property and develop-

being accumulated, as the management is generally disposed to follow a conservative policy instead of making too lavish a distribution of dividends. The older Cobalt companies, which are approaching the exhaustion of their ore-reserves, are largely investing in new properties so as to be in a position to continue elsewhere when their present holdings are worked out.

PORCUPINE.—The Hollinger will make a start this season on the development of the Miller-Middleton property, bordering on the Porcupine Crown and Moneta locations. There are a number of veins on the surface and others have been determined by diamond-drilling. At the McIntyre vein No. 5, which is being developed on



THE COPPER LEAF MINE IN THE TINTIC DISTRICT, UTAH

ment, it is stated, is to be done on a considerable scale. Last December this company took a conditional bond on the Yankee Girl and subsequently A. W. Newberry, of New York, made an examination. It is understood that there will be a new corporation known as the Texas Yankee Girl Mining Co., under which the mine and adjoining mineral property will be developed and operated.

GRAND FORKS.—The Provincial government has decided to undertake some diamond-drilling on properties at Franklin, situated close to Grand Forks. The Mitchell Diamond Drill Contracting Co. is preparing to start work under the direction of P. B. Freeland, district engineer, as soon as weather conditions permit.

ONTARIO

REPORTS FROM NORTHERN ONTARIO ARE ENCOURAGING.—
LABOR SHORTAGE AT SUDBURY.

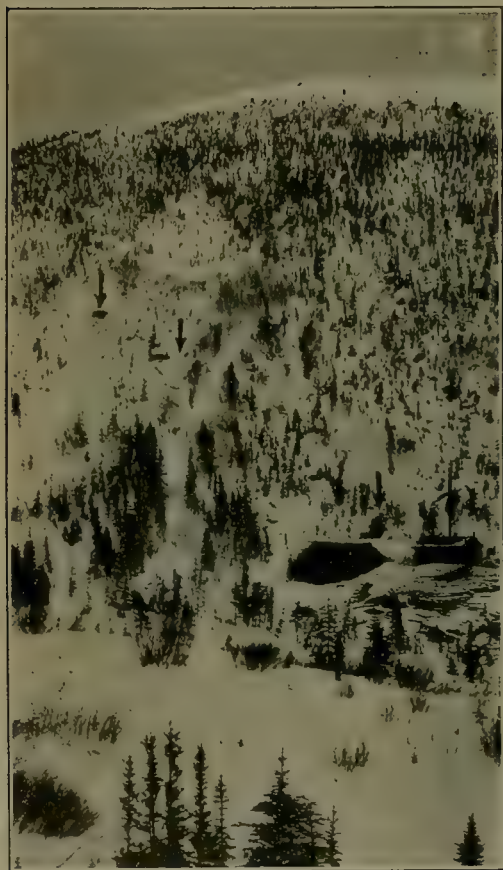
TORONTO.—Recent annual reports of the leading gold and silver mines of Northern Ontario are of a decidedly encouraging character, indicating that the industry is on a satisfactory basis. Large surpluses are in some cases

the 1250-ft. level, shows higher gold content than on the upper levels. The shaft has reached a depth of 1550 ft., and will be continued to 2000 ft. Cross-cutting is being carried on at the 1375 and 1500-ft. levels to tap No. 5 vein. The mill-heading is averaging about \$11 per ton and some 600 tons is being treated daily. The company has now a full force on the payroll.

COBALT.—The Nipissing during March mined ore of an estimated value of \$384,723 and shipped smelting ore of an estimated value of \$136,771. The annual statement of the Beaver Consolidated for the fiscal year ended February 29 shows a production of 301,781 oz. of silver; as compared with 385,042 oz. in the previous year. The profits were \$158,215. During the year large bodies of milling ore have been opened up, which it is profitable to work at present prices, and some high-grade shoots have also been found. The proposed sale of the assets of the University mine to the La Rose Mines has been stayed by a temporary injunction granted to the minority shareholders. The La Rose already owns 98% of the stock, and it was arranged to hand over the assets in discharge of a liability of \$61,000. The minority shareholders con-

tend that the deal is an unfair one and an infringement of their rights. Additions and improvements to the mill of the Temiskaming have increased production and an average of 100 tons per day is now being treated. At the Genessee a winze is being sunk from the 500-ft. level down to the contact, estimated to be at a further depth of 110 ft. The vein which is being followed carries from 2 to 6 in. of 400-oz. ore. The Rochester mine has been leased by R. H. Lyman, who will begin exploration work at once.

During the year 1919 the Trethewey mine produced



THE LOOKOUT MINE, YUKON TERRITORY. THE ARROWS INDICATE THE ADITS

\$169,294, and realized a net profit of \$31,814. This compares with a net profit of \$106,872 for the previous year. The company, having sold its property for \$100,000 early in the current year, is now devoting its entire attention to the development of the Castle properties in the Gowganda district. It is stated that these properties are now practically self-supporting.

The McKinley-Darragh has submitted a quarterly financial statement for the first quarter of 1920, before some of the less business-like companies have issued their annual reports for the calendar year 1919. The same is true of the Kerr Lake Mining Co., which early this month

issued a half-yearly report for the period August 31 to February 29. McKinley-Darragh finances as of the first quarter are summed up as follows: Cash in bank, \$203,394; Canadian victory-loan bonds, \$100,000; ore in transit and at smelter, \$127,700; ore at mine ready for shipment, \$43,570; making a total of \$474,864 in cash and realizable assets.

The Kerr Lake Mining Co. announces that it has acquired a majority interest in a silver mine in Utah as well as a gold-dredging property in New Zealand. It is stated that the Utah property commenced production last December and is equipped with a mill with a capacity for 150 tons of ore daily. Ore in sight is estimated at 87,000 tons, and is said to contain 18 oz. silver and 80c. gold per ton. The name of the mine is not given. The New Zealand property is said to have been thoroughly tested, and it is estimated that the net profits from the alluvial deposits will amount to at least \$3,436,000, after deducting the cost of the property and equipment.

The Coniagas Mines will pay a dividend of $2\frac{1}{2}\%$ on May 1, plus a bonus of equal amount. The double disbursement will amount to \$200,000, and make the total to date \$10,040,000.

PENSE TOWNSHIP.—A report that discoveries of silver have been made in Pense township, lying about 25 miles north of New Liskeard and south-east of the Boston Creek area, has resulted in a rush of prospectors. Upward of one hundred claims have been staked and recorded, largely by representatives of Toronto interests. Details of the reported discoveries are lacking, but according to reports of the Ontario Bureau of Mines, the geological conditions are highly favorable and the finding of silver ore is considered probable.

SUDBURY.—The International Nickel Co. is unable to procure sufficient unskilled labor in Ontario owing to the exodus of foreign laborers in large numbers. Arthur Desantels, assistant manager, has gone to Winnipeg to secure men. The wages offered are 53c. per hour for muckers and 59c. for semi-skilled workers.

YUKON

THE LOOKOUT MINE.

MAYO.—The Lookout mine is situated near Lookout mountain, on Big Horn creek, a tributary of the McQuesten river, which flows into the Stewart. The mine is 26 miles from Mayo, a good wagon road connecting the two points. The elevation is 3500 ft. above tidewater. A crew of 12 men has been developing all winter and will deliver about 300 tons of high-grade galena ore at Mayo for shipment as soon as navigation opens.

The working tunnel is 700 ft. below the top of the hill. The middle tunnel is 250 ft., and the upper opening is 300 ft. up the hill. All the development has been done by local men and local capital and indications point to the Lookout being a steady producer. The assays run from 20 to 310 oz. silver per ton and 70% lead, the average being about 75 oz. silver. The property includes six claims each 1500 ft. square and a smaller fraction.



CALIFORNIA

Amador County.—At the annual meeting in London the following official statement of operations at the Plymouth Consolidated was made:

W. J. Loring has handled the labor situation with the same tact and skill as in the past, and as a result he has succeeded in obtaining the number of men required, although, owing to the scarcity of experienced miners, it has been necessary, to a great extent, to teach and qualify the men for the work required of them. This serious shortage, with the increased cost of all materials, has upset altogether the pre-war standard of working costs, and has resulted in the closing down of many mines. A smaller tonnage of ore was opened up than in 1918. This was partly due to the failure, so far, to open up, on the 1850-ft. and lower levels, the ore-shoot which was developed with such satisfactory results in the earlier part of the year on the 1600-ft. level. Again, some delay in development operations was caused by the heaviness of the ground, which made it necessary to take special steps to strengthen the shaft. However, a new level has been opened up at 2750 ft. where the north foot-wall drift shows, up to the present, 70 ft. of good ore over a width of 62 in. On the 1500-ft. level the south drift has been extended to intersect what is known as the No. 2 south ore-shoot. This orebody has been cut, and so far is showing good results. A considerable amount of what might be called 'prospective' development work has been carried out in various parts of the mine with promising results. The operations since the close of the year have been equally promising.

IDAHO

Coeur d'Alene.—The Haynes mill, at the mouth of Pine creek, is handling about 60 tons of ore per day and is shipping five cars of concentrate per month to the Bunker Hill smelter at Kellogg. The feed averages about 5% and the product 30% lead, and 24 oz. silver per ton.

The Ajax Mining Co. has picked up the vein again on the 750-ft. level, according to report. The vein is narrow, but promising.—The Willow Creek Mining Co., whose property is south of the Carney and east of the Carbonate Hill, near Mullan, has resumed operations. The tunnel has a length of 170 ft. and will be driven an equal distance farther to tap the vein which indicates lead-silver ore at the surface.

The Nabob Consolidated Mining Co., in the Pine Creek district, has accumulated two carloads more in the bins at the mill, according to B. N. Sharp, superintendent. The concentrate averages about 50% lead and 20 oz. silver per ton, and the net value is about \$70 per ton. The tailing contains 0.7% lead. This is an average of the tailing since the mill was started. The orebody struck recently on the Denver tunnel level has a width of four feet at the face, as compared with one foot at a point 15 ft. back in the drift.

Elmore County.—Gold ore seven feet wide has been found by the Gold Mines Co. on its property, near Mountain Home, according to report. The shoot was opened at a depth of 350 ft. by a tunnel driven more than 700 ft., and contains \$10 to \$25 per ton. A contract has been let for drifting on the vein. The ore can be dressed on the property by amal-

gamation and cyanide. The building of a mill will be considered when the development has proceeded further.

Halley.—Galena ore in a vein six inches to two feet wide has been cut in the Queen of the Hills mine, one mile from Bellevue. A sample contained 2% lead and was rich in silver. High-grade ore found in other parts of the mine usually contains 150 to 200 oz. silver per ton.

Lewiston.—Free-milling ore has been found in a large vein in the Swastika group of mines six miles south and east of Dixie. It is said that several assays run \$60 per ton and one goes \$100. Eastern capital has been developing the property for several years. Two shifts are at work.

NEVADA

Austin.—Shipments have begun from the 200-ft. level of the Austin Dakota to a Utah smelter. The south-east cross-cut from the 300-ft. level has intersected a vein believed to be the Dalton. About 12 in. of shipping ore is opened, together with a wide face of milling ore.—Operations have been resumed on the Cahill Lode group, in the Birch Creek district, with one shift. The shaft has passed through the limestone and entered basalt. Within 30 ft. Jack Cahill, the manager, expects to encounter the Cahill lode.—The Nevada Birch Creek Co. is sacking ore from the upper tunnel workings and will ship as soon as the roads are in shape for heavy traffic. The raise from the lower tunnel is entering a formation with stringers of quartz.—The Birch Creek Mining Co. has purchased a 15-hp. gasoline hoist preliminary to sinking a 200-ft. shaft on the Bradley group. F. L. Andregg is superintendent.

Mina.—Construction of a 45-ton cyanide mill has begun at the Olympic gold mine, near Gunco. The plant will replace the 100-ton mill destroyed by fire on November 21, and is said to represent an expenditure of approximately \$100,000. The Olympic Mines Co. recently purchased the nearby Loo mine and will supply the mill with ore from both properties.

Pioche.—Negotiations are proceeding for re-opening of the Mazeppa property under new management. Development consists of an 825-ft. shaft and lateral workings, with the orebody showing consistent strength in the deeper workings. The main orebody, opened to a vertical depth of 800 ft. from the surface, yielded over \$1,000,000 in pioneer days of Pioche. The ore is largely silver-lead. It is probable that the new work will be carried on from the Meadow Valley shaft. Large reserves of medium-grade ore are said to be blocked out in old workings.

Wonder.—Consolidation of the Dickey V., Spider-Wasp, Golconda, Bald Eagle, and Vulture properties has been effected by George A. Manning and associates of New York. It is stated that a mill will be erected during the summer, and that development of the merged properties will be pushed.

MEXICO

Pachuca.—Official advices state that the deaths resulting from the fire in the El Bordo mine, recently acquired by the Santa Gertrudis company, numbered 75 as against the first report of 136 missing. The fire occurred between the 305 and 415-ft. levels on March 10, and the extent of the damage

is not yet determined. The casualties were among the natives and none of the supervising staff was injured.

FELLOWSHIPS IN METALLURGY AT THE UTAH SCHOOL OF MINES AND ENGINEERING

Invitation has been extended to qualified men to make application for fellowships in the Department of Metallurgical Research during the year 1920-1921. This department is maintained in connection with the Utah Station of the United States Bureau of Mines. By agreement the work of this department is under the immediate supervision of metallurgists of the Bureau, assigned to duty at this station. During the coming year, 1920-1921, the problems to be continued are the following:

(1) General ore-dressing problems, (2) special problems bearing on the flotation treatment of ores, (3) volatilization process and its application to gold-silver ores, (4) volatilization process and its application to lead ores, (5) volatilization process and its application to copper ores, (6) hydro-metallurgy of zinc, and (7) oil-shale investigations.

The openings announced afford an excellent opportunity for qualified young men to become experts in the fields of mining and metallurgy and to prepare themselves for special highly technical work in these fields. Those who receive this training have been, and are, in great demand at remunerative salaries. There are several fellowships to be awarded, each having an annual value of \$720. These fellowships are open to college graduates who have had a good training in chemistry and metallurgy and applications for them will be received up to May 15, 1920. Applicants should send a copy of their records from the registrar's office of the college where they have, or will be, graduated and the names and addresses of at least three references who know their character, ability, and attainments.

Holders of these fellowships will be subject to the rules governing employees of the United States Bureau of Mines and will report for duty about July 1, 1920. They must also register as students in the University of Utah and become candidates for the degree of Master of Science in Metallurgy (unless this or an equivalent degree has been previously earned). Their class work will be directed by the heads of the departments of instruction and their laboratory work by metallurgists of the Bureau of Mines. Fellows are appointed for one year, but the appointment may be renewed. Fellows have no laboratory fees to pay. Applications should be addressed to Jos. F. Merrill, Director of the Utah State School of Mines and Engineering, Salt Lake City.

Obituary

William Weston died on March 30 at Denver, succumbing to an attack of pneumonia at the age of 76. He came to Colorado first in 1870, from London, on a hunting tour. Later he became general traveling agent for the Kansas Pacific Railroad, doing much to advertise Colorado. He was engaged in mining in various parts of the State, notably as advisor to David H. Moffat. He was a familiar and respected figure in Denver mining circles and will be mourned by many old friends.

Harry Haskell Small, sales manager for the Goodman Manufacturing Co., Chicago, died on April 4, after a brief illness. He was born October 7, 1862, at Portland, Maine. His public-school education was supplemented by preparatory work at Phillips Exeter Academy and by technical training at Worcester Polytechnic Institute. After association with other industries he came to the Goodman Manufacturing Co. in 1901, as manager of the contract department, from which position he was promoted to that of sales manager in 1912. He had a wide acquaintance throughout the mining industry and was held in high esteem by all who knew him.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Albert C. Burrage is at Salt Lake City.

L. W. Storm, of Seattle, is in San Francisco.

Harry J. Wolf, of New York, is in Arizona.

Jay P. Graves has returned from Pasadena to Spokane.

D. D. Moffat was recently at McGill, Nevada, on an inspection trip to the Nevada Con. mill.

Louis S. Cates, manager for the Utah Copper Co., was in San Francisco recently for a few days.

Walter Karri-Davies has gone from Victoria, B. C., to London. He expects to return shortly.

George T. Jackson, manager for the Alaska Gold Mines Co., has returned from San Francisco to Juneau.

C. Erb Wuensch has gone to Salvador, where he will engage in making geologic investigations for three months.

Charles H. White is on a motor tour to the Grand Canyon, proceeding thence to Globe, Arizona, on professional work.

Frederick Cowans, general manager for the Utah Consolidated Mining Co., of Bingham, is in California on a vacation.

C. F. Kelley, of the Anaconda Copper Co., was at Soda Springs, Idaho, recently, inspecting phosphate deposits in that vicinity.

John T. Reid has left New York for his home at Lovelock, Nevada, where he will spend the summer, returning to New York next fall.

L. V. Cummins passed through San Francisco last week on his way from Yokohama to New York. He will return to Japan on June 30.

Walter Fitch, president of the Chief Consolidated Mining Co., has returned to his home at Eureka, Utah, after a vacation in southern California.

F. A. Goodale has returned from Queensland, where he has been examining alluvial deposits, and is now with the You Bet Mining Co., at Colfax, California.

P. J. Mackintosh, general manager for the Three Kings Mining Co., at Park City, Utah, has returned to his headquarters at Salt Lake City after a trip to Pittsburgh.

A. L. Gholz, superintendent of the contract drilling department for the E. J. Longyear Co., passed through San Francisco on his way from Minneapolis to Los Angeles and Arizona.

Clarence W. Burton, of Salt Lake City, has accepted the position of resident engineer for the Ontario Silver, Keystone, and Nalldriver mining companies. He will make his headquarters at Park City, Utah.

S. Paul Lindau has resigned his position with the St. Joseph Lead Co., at Herculaneum, Missouri, to accept a position as assistant superintendent for the Compania Metalurgica Mexicana, at San Luis Potosi, Mexico.

G. P. Bartholomew and **John C. Emission** have been elected directors of the American Smelting & Refining Co., to succeed **Karl Eilers** and **Leopold Frederick**, who have retired. Mr. Emission has recently become associated with the company, after 15 years service with the National City Bank of New York.

O. B. Smith, a graduate of the 'Tech' ('97), has resigned as assistant to the managing director and head of the exploration department of the Granby Consolidated Mining, Smelting & Power Co. He has been with this company for 21 years. From 1908 to 1919 he was general superintendent of the mines. It was on his joint report with **H. J. C. MacDonald** that the company acquired the Hidden Creek property at Anyox. His resignation is prompted by ill health.

THE METAL MARKET



METAL PRICES

San Francisco, April 20

Aluminum-dust, cents per pound.....	85
Antimony, cents per pound.....	11
Copper, electrolytic, cents per pound.....	19.25
Lead, pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$133
Platinum, 10% iridium, per ounce.....	\$100
Quicksilver, per flask of 75 lb.....	\$100
Spelter, cents per pound.....	10.25
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

April 19.—Copper is inactive but steady. Lead is lifeless and lower. Zinc is dull and easier.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 6, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending			
Apr. 13.....	119.00	69.25	Mch. 8.....	130.37	81.16	
" 14.....	119.50	68.75	" 15.....	121.90	72.14	
" 15.....	118.00	68.00	" 22.....	123.42	70.35	
" 16.....	117.75	67.75	" 29.....	125.81	71.64	
" 17.....	117.25	68.25	Apr. 5.....	126.50	72.29	
" 18 Sunday.....			" 12.....	123.75	70.75	
" 19.....	117.25	68.50	" 19.....	118.12	68.41	
Monthly averages						
	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.38
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92
Apr.	95.35	101.12	Oct.	101.12	119.10
May	99.50	107.23	Nov.	101.12	127.57
June	89.50	110.50	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 13.....	19.25			Mar. 8.....	18.62		
" 14.....	19.25			" 15.....	18.37		
" 15.....	19.25			" 22.....	18.10		
" 16.....	19.25			" 29.....	18.66		
" 17.....	19.25			Apr. 5.....	19.10		
" 18 Sunday.....				" 12.....	19.25		
" 19.....	19.25			" 19.....	19.25		
Monthly averages							
Jan.	23.50	20.43	19.25	July	26.00	20.82	.....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	.....
Mar.	23.50	15.05	18.49	Sept.	26.00	22.10	.....
Apr.	23.50	15.23	.....	Oct.	26.00	21.66	.....
May	23.50	15.21	.....	Nov.	26.00	20.45	.....
June	23.50	17.53	.....	Dec.	26.00	18.55	.....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 13.....	8.75			Mar. 8.....	9.43		
" 14.....	8.75			" 15.....	9.50		
" 15.....	8.75			" 22.....	9.10		
" 16.....	8.75			" 29.....	8.96		
" 17.....	8.70			Apr. 5.....	8.92		
" 18 Sunday.....				" 12.....	8.78		
" 19.....	8.60			" 19.....	8.71		
Monthly averages							
Jan.	6.85	5.00	8.65	July	8.03	5.53	.....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	.....
Mar.	7.28	5.24	9.22	Sept.	8.05	6.02	.....
Apr.	6.99	5.05	.....	Oct.	8.05	6.40	.....
May	6.88	5.04	.....	Nov.	8.05	6.76	.....
June	7.59	5.32	.....	Dec.	6.90	7.12	.....

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	.....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	.....
Mar.	85.00	72.50	61.92	Sept.	80.40	55.79	.....
Apr.	88.53	72.50	.....	Oct.	78.82	54.82	.....
May	108.01	72.50	.....	Nov.	73.67	54.17	.....
June	91.00	71.83	.....	Dec.	71.52	54.94	.....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 13.....	9.25			Mar. 8.....	8.98		
" 14.....	9.00			" 15.....	9.06		
" 15.....	8.85			" 22.....	8.91		
" 16.....	8.85			" 29.....	8.87		
" 17.....	8.85			Apr. 5.....	8.93		
" 18 Sunday.....				" 12.....	9.17		
" 19.....	8.85			" 19.....	8.94		
Monthly averages							
Jan.	7.78	7.44	9.58	July	8.72	7.78	.....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	.....
Mar.	7.67	6.53	8.93	Sept.	9.58	7.57	.....
Apr.	7.04	6.49	.....	Oct.	9.11	7.83	.....
May	7.92	6.43	.....	Nov.	8.75	8.12	.....
June	7.92	6.91	.....	Dec.	8.49	8.69	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	Average week ending	1918	1919	1920
Apr. 23.....	90.00			Mar. 8.....	100.00		
" 30.....	95.00			" 15.....	100.00		
" 20.....				" 20.....	100.00		
Monthly averages							
Jan.	128.06	103.75	89.00	July	120.00	100.00	.....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	.....
Mar.	112.00	72.80	87.00	Sept.	120.00	102.60	.....
Apr.	115.00	73.12	.....	Oct.	120.00	86.00	.....
May	110.00	84.80	.....	Nov.	120.00	78.00	.....
June	112.00	94.40	.....	Dec.	115.00	95.00	.....

TARIFF ON TUNGSTEN

The following is from the report of the Committee of Finance on H.R. 4437, providing for a tariff on tungsten:

Tungsten is a vitally important war metal. It is equally important in our industrial peace program. Tungsten is the only known element which forms an alloy with steel, giving to this steel the property of retaining its temper at extremely high temperatures. This property, together with its hardness, makes possible the manufacture of tools for drilling, cutting, and finishing steel products. Those tools are operated at such high speed that one machinist and one lathe can do as much as five machinists and five lathes equipped with carbon-steel tools. Quantity production is dependent on high-speed tungsten steel.

Prior to the War Germany controlled the tungsten refining industry and very little tungsten was refined in the United States. During the War the tungsten industry was fully established and the United States became the leading nation in the manufacture of tungsten products.

The mining of tungsten in the United States was greatly stimulated during the War and the production, in 1917, reached 8144 tons of 60% concentrate. The evidence showed that the normal requirements of this country were between 5000 and 7500 tons of 60% concentrate per year. The annual production from the equipped mines that can be operated under the proposed duty was demonstrated to be from 4000 to 4500 tons per year. It is claimed through the stabilization of price and stimulus of the duty, that this production can gradually be increased until our entire domestic requirements will be supplied. During that period of development a substantial revenue would be received from importations of ore.

The destructive competition which American producers are helpless to meet comes from the ores of Asia. The costs of domestic production were proved from certified statements to average \$13 per unit. The foreign costs were shown to be from \$2 to \$4 per unit; and foreign ores are being sold in New York at from \$6 to \$7.50 per unit. Large quantities, aggregating about 50,000 units per month, are being imported, duty free, and none is being produced now in the United States. The difference in costs are not due alone to the discrepancy in high wages paid our American miners (from \$4.65 to \$6.50 per day) and the pitance paid Asiatic coolies (from 20c. to 50c. per day), but the physical character of the deposits is different. Most foreign ores are recovered from rich surface deposits, that require little or no equipment, while American ores are recovered from veins or lodges of hard rock. Expensive mine equipment is required and large costly mills are necessary, as the ore has to be crushed and concentrated to put it into a marketable product.

It has been shown that the tungsten-mining industry is in a critical condition. Unless prompt action is taken it will be destroyed. Every mine in the United States is closed down, and without the duty asked for cannot re-open. The industry which has proved of such vital importance during the War will fall in decay, so it cannot be rehabilitated and the country will be left to the mercy of Asiatic production to supply material as necessary in our industrial peace program as it is essential in war.

From the showing made it is perfectly evident that this industry should be protected. Without a healthy tungsten industry the United States will be completely at the mercy of hostile nations, which could instantly cut off supplies. The production of war material would be paralyzed.

MONEY AND EXCHANGE

Foreign quotations on April 20 are as follows:

Sterling, dollars:	Cable	3.97
	Demand	3.96
Francs, cents:	Cable	6.36
	Demand	6.35
Lire, cents:	Demand	4.63
Marks, cents:	Demand	1.70

Eastern Metal Market

New York, April 14.

The railroad strike in the Central States and in the East is a predominating factor, making for hesitancy in all markets. Movement of all metals is held up. The markets are therefore quiet but steady.

Copper buying has fallen off but quotations of leading producers are firm. The outside market is lower.

The tin market is quiet following a heavy buying movement last week.

Lead prices in the outside market have advanced and demand is larger than the supply. The zinc market is quiet and prices are easier.

Quotations for antimony are lower.

IRON AND STEEL

The railroad strike has reduced activity in the steel industry to nearly half. Should the trouble last a few days longer nearly all the steel plants and rolling-mills will be closed almost completely. Many plants are operating only on stocks of fuel and raw materials, but no finished products can be shipped. The trade expects that resumption will be a straggling process, with shut-downs in one section and work resumed in others. The Chicago district was hit the hardest.

A feature of recent operations is the high steel-ingot output in March, which was at the rate of more than 145,000 tons per day, or 45,000,000 tons per year; the heaviest year, 1917, showed 43,619,000 tons.

COPPER

The heavy buying movement of late March and early April has subsided and demand now is light. This has been intensified by the serious railroad situation. Lighter demand, however, was to be expected following heavy purchases, as probably many large consumers are covered for April-May and perhaps second-quarter needs. The large producers are firmly quoting at 19.25c., New York, for electrolytic copper for April-May delivery with a premium for June and are not inclined to quote for the third quarter. Lake copper is unchanged at 19.50c., New York. There is also an outside or secondary market in which copper, from small producers and dealers, is obtainable at as low as 18.50c., New York, for delivery during second quarter. Foreign demand is also light under present conditions. Germany has, however, in the past purchased a surprisingly large amount as judged by her financial position and other considerations.

TIN

A shortage of metal, as mentioned in last week's letter, for late April and early May consumption as a result of the small quantity of tin afloat and in stock and landing on March 31, appears almost certain in view of March statistics published last week. This situation was sensed by buyers who at once realized its seriousness and entered the market. As a result there was heavy buying on Thursday and Friday, April 8 and 9, spot Straits selling on Thursday at a range of 61.25 to 61.50c., and on Friday at a range of 61.50 to 62c., New York. This buying was for prompt delivery and for metal to arrive in April and May. The demand became so heavy that the buying broadened into future shipments. The purchasing was participated in mostly by large consumers and to some extent by dealers. The buying and selling were both of a general nature. The small shipments from the East had set the trade to thinking. Thus far this week the market has been quiet and the buying light, due partly to an advance in London of £13 per ton on Monday and £1 yesterday, bringing the price of spot Straits yesterday to £346 5s. per ton. The market was quoted yesterday at 63.25c., New York, for spot Straits. This has temporarily stopped buying

by consumers who still adhere to a policy of buying on the dips and abstaining on the bulges. Should London recede, another spurt of buying is anticipated here. The arrivals thus far this month have been only 934 tons with 3916 tons reported afloat.

LEAD

The tendency to a return of strength noted last week has been intensified. The market is stronger and prices are higher in the outside market. They have even reached a parity with those of the leading interest so that lead for early shipment is quoted at 9.25c., New York, or 9c., St. Louis, in both markets. It is impossible to buy the metal for early delivery at less than 9.25c., New York, and early shipment has sold at as high as 9.37c.; for June at 9.50c.

ZINC

The market has receded slightly owing to two causes. One is the railroad strike, which has affected freight from the Atlantic as far west as St. Louis, where zinc originates, and the other is the selling in this market by British traders of metal bought for export but which can be sold to advantage here and re-purchased at a lower level in London, the market there having receded decidedly recently. Prime Western for early and second quarter delivery is quoted at 8.40c., St. Louis, or 8.75c., New York.

ANTIMONY

Quietness continues to pervade the market and demand has slackened. The better grades are obtainable at around 11c. per pound, New York, duty paid, in wholesale lots for early delivery.

ALUMINUM

Wholesale quantities, virgin metal, 98 to 99% pure, are obtainable for early delivery at 33c., from the leading producers, and at 31c. per pound from outside sellers.

ORES

Tungsten: Buyers are keenly interested in the tariff development. Confidence is growing that the bill will be passed, one reason offered being that votes for a tariff on dyes will be needed and can be exchanged for votes for the tungsten tariff. The market is firmer if anything. Ore prices are said to be at a minimum of \$7 per unit for low-grade material.

Ferro-tungsten is quoted at 85c. to \$1.15 per pound of contained tungsten. There is less tendency to import the British alloy because higher exchange rates have caused an advance in the cost of the British product.

Molybdenum: There is no business reported and quotations are unchanged and nominal at 75c. per pound of MoS₂ in regular concentrates.

Manganese: Quotations are unchanged at 80c. per unit for high-grade ore, seaboard, for early delivery and possibly as low as 65c. per unit for later delivery. Some foreign ore is available at these figures but no sales were recorded during the past week.

Manganese-Iron Alloys: The ferro-manganese market is strong with demand for early delivery more active. Prices are unchanged at \$225 to \$250, delivered, for prompt and early delivery at which some sales are recorded of both British and American alloy, but in limited quantities. The American product thus sold has been mostly electric alloy. The quotation for last half continues \$200, delivered, for the American alloy, with some British available at \$195, seaboard, for shipment during and after August. Spiegeleisen is quoted from \$64 to \$75, furnace, by two different makers, but some alloy, 18 to 22%, evidently re-sale, has sold at \$58, furnace.

Company Reports

JIM BUTLER TONOPAH MINING CO.

Report for the year ended December 31, 1919.

Property: mine and mill at Tonopah, Nevada.

Operating Officials: Frederick Bradshaw, general superintendent; L. R. Robins, mining engineer.

Financial Statement: receipts from shipments of ore, \$104,664; miscellaneous income, \$12,705; total, \$117,369; operating cost, \$91,389; net loss on Belmont-Shawmut Mining Co., \$49,875, and on Belmont-Wagner Co., \$41,848.

Dividends: none in 1919; total to date, \$1,151,074.

Development: 1159 ft. of development work was performed in the Wandering Boy mine, but no orebodies of great size have been found. The small remaining ore-reserves are expected to produce only small profits.

Production: 5711 tons of ore was treated with an assay value of \$23.48 per ton. The net realization after deducting mining, transportation, and milling charges, was \$6.62 per ton.

YUKON GOLD COMPANY.

Report for the year ended December 31, 1919

Property: 650 claims in the Yukon Territory, 24 claims in the Iditarod district, Alaska, and dredging-land in California; also lease near Murray, Idaho.

Operating Officials: O. B. Perry, general manager; E. E. McCarthy, resident manager in Yukon Territory.

Financial Statement: operating gain from the various properties was as follows: dredges at Dawson, \$182,511; hydraulic operations at Dawson, \$161,128; dredges in California, \$71,274; dredge at Murray, \$52,845; miscellaneous, \$41,131; total, \$508,890. Charge for depletion, \$303,963; depreciation, \$486,896; stock investments written off, \$653,156. Net deficit for the season, \$1,108,684.

Dividends: none in 1919; total to date, \$9,858,110.

Development: the exploitation of placer tin by dredging in the Federated Malay States is under way. Sufficient ground for three dredges has already been proved, and two dredges, together with a steam-turbine generator plant, are on the way to Malay.

Production: the value of the total production was \$1,699,632, the Dawson dredges producing 40% of the total.

OLD DOMINION COMPANY

Report for the year ended December 31, 1919.

Property: the company controls the Old Dominion Copper Mining & Smelting Co. and the United Globe Mines, with mines, mill, and smelter in the Globe district, Arizona.

Operating Officials: W. C. McBride, general manager; I. H. Barkdall, mine superintendent; H. H. Colley, smelter superintendent.

Financial Statement: income from sale of copper, silver, and gold, \$3,205,879; mining, treating, and refining expense, \$5,012,629; charge for depreciation, \$325,042; depletion, \$346,000; selling and general expense, \$83,074; interest, \$125,442. The company had \$4,214,775 of finished metals on hand on December 31, as compared with \$2,251,266 on January 1. Net loss, \$723,135.

Dividends: no dividends in 1919; total to date, \$14,405,260.

Development: 25,844 ft. of development work was accomplished. The development on the 17th and 18th levels in the western part of the mine was disappointing but did not definitely show that the continuation of orebodies will not yet be discovered.

Production: 50,188 tons of smelting ore, 200,304 tons of concentrating ore, and 3194 tons of converting ore, with an average copper content of 4.28%, produced 28,166,396 lb. of refined copper with 137,071 oz. silver and 5755 oz. gold.

The smelter was operated at an increased cost because of the small tonnage treated.

AMERICAN ZINC, LEAD & SMELTING CO.

Report for the year ended December 31, 1919.

Property: mines in the Joplin district, Missouri; smelting plants in Kansas and at Granby, Missouri. There are subsidiary companies in Tennessee, Wisconsin, Illinois, and Missouri.

Operating Officials: H. R. Young, manager of mines; C. B. Strachan, superintendent of the Tennessee mines.

Financial Statement: the consolidated balance-sheet, which includes the subsidiary companies, shows an operating loss of \$19,266 after allowing deductions for mining, manufacture, marketing, general and excess profits taxes, and interest. Miscellaneous profits were \$451,304, making a total profit of \$432,038. Surplus, December 31, 1918, was \$4,421,722, and December 31, 1919, was \$3,695,152.

Dividends: on the preferred stock, \$482,037 was paid; total to date, \$613,620.

Development: ore-reserves at the Mascot property at the end of the year materially exceeded those at the beginning. To meet the increasing demand for lead-free zinc oxide a new plant was started at Columbus, Ohio. The zinc-oxide plant at Hillsboro, the sulphuric-acid plant at East St. Louis, and the limestone plant at Mascot, Tennessee, were improved and added to.

UTAH CONSOLIDATED MINING CO.

Report for the year ended December 31, 1919.

Property: mine at Bingham, Utah.

Operating Officials: Frederick Cowans, general manager; A. S. Winther, superintendent.

Financial Statement: mining expenses, \$799,829; development, \$245,111; ore-testing, \$32,820. Total, \$1,077,759. Smelting charges, \$632,807; litigation, \$116,403. Proceeds from sale of products, \$1,971,631; miscellaneous deductions, \$168,539. Profit for the year, \$181,966.

Dividends: none during 1919. Total to date, \$12,810,000.

Development: 17,407 ft. of development and exploration work maintained the ore-reserves on a par with those at the beginning of the year. The newly opened ore is on the 1800 and 2000-ft. levels. The 2200-ft. level was opened. Laboratory experiments on flotation treatment of copper ore were confirmed by a mill-test on 2500 tons and plans were completed for a 1000-ton mill.

Production: 126,893 tons of copper ore and 45,377 tons of lead ore yielded 5,710,346 lb. of copper, 13,072,177 lb. of lead, 373,179 oz. of silver, and 10,548 oz. of gold.

SHATTUCK ARIZONA COPPER COMPANY

Report for the year ended December 31, 1919.

Property: mine and mill at Bisbee, Arizona.

Operating Officials: L. C. Shattuck, general manager; Arthur Houle, superintendent.

Financial Statement: gross value of production, \$1,017,359; miscellaneous receipts, \$52,339; cost of mining, refining, and marketing, \$1,054,656; administration, \$36,935. Loss, \$21,893. Depletion and depreciation \$164,606. Net loss, \$186,500. Surplus balance on December 31, \$557,671.

Dividends: during 1919, \$437,500. Total to date, \$7,612,500.

Development: this work was hampered by an underground fire, which necessitated the flooding of the mine below the 700-ft. level. The work of pumping the water is now completed. Rich copper ore has been found in ground south of the previously known ore-zone; 4244 ft. of this character of work was done.

Production: 22,011 tons of copper ore and 49,150 tons of lead ore were mined, from which 2,111,841 lb. of copper, 257,749 oz. of silver, 4,432,655 lb. of lead concentrate, and some gold were produced.

Book Reviews

Traverse Tables. Henry Louis and G. W. Caunt. Second edition. Pp. 123. Edward Arnold, London. For sale by Mining and Scientific Press. Price, \$2.

This is an ordinary book of traverse tables varying by minutes. There is also a discussion of platting and computing surveys by co-ordinates. The relatively small number of surveyors that use traverse tables in their work will find this book as good as any on the market.

Mechanical World Year Book for 1920. Pp. 328. Ill., index. Emmott & Co., Manchester, England.

The present edition of this useful handbook has been enlarged and revised, the greatest additions being in the divisions on water and hydraulic work and on heating and evaporating liquids. Other important additions are to the division on compressed air and to the screw-thread tables. While the book is not so complete as many of the American handbooks, the material included is well selected. Naturally the book is suited more to the needs of the British than the American engineer.

Mining Manual and Mining Year Book, 1920. Compiled by Walter R. Skinner. Pp. 832. Index. Walter R. Skinner and 'The Financial Times', London.

This is the thirty-fourth consecutive issue of this standard reference work on mines. The object of the book is to place before the mining industry facts and figures in such form as to enable those interested to see at a glance the condition and prospects of mining enterprises throughout the world. The number of companies dealt with in the 1920 volume is 1400. The figures are based on authoritative information, and the last balance-sheet of the companies dealt with is given. In the appendix is an alphabetical list of directors of mining companies, engineers, and managers, with their addresses and affiliations. There is also an up-to-date glossary of mining terms.

Manual of Cyanidation. By E. M. Hamilton. Pp. 278, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The avowed purpose of the book is to give practical assistance to the designer, builder, or operator of a cyanide-plant. Purely theoretical considerations are largely kept in the background. Various phases of cyanide work are discussed more in detail than seems necessary for the metallurgist, the reason being a desire to make the book available for the use of students. The chapter headings show the scope of the treatise: Notes on the Chemistry of the Process; Testing and Analysis of Solutions; Sand Leaching; Slime Treatment; Milling in Cyanide Solution; Discrepancies Between Actual Recovery and Theoretical Extraction (3 chapters); Ores Presenting Special Difficulties; Precipitation; Cleaning-Up and Melting; Laboratory Experiments; Cost-Sheets and Plant Data; and Tables. While there is little new in the book the data are conveniently presented.

The Lathe, Bench-Work, and Work at the Forge. By Henry D. Burghardt. Pp. 318. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.

The author is instructor in machine work in a high school in Jersey City, and the book is addressed primarily to the boy or man learning the trade. Thus the first chapter is devoted to a general discussion of the machinist's trade. Then the general features of the lathe are considered, followed by a discussion of cutting tools and speeds and of gauges and micrometers. The various operations of centring, facing,

chucking, and turning are then considered, as well as the cutting of tapers and of screw-threads. Three chapters are then devoted to the various aspects of bench-work. The chapter on forge-work is brief and is concerned entirely with babbitting, brazing, soldering, and the tempering of tools. An appendix contains a number of useful tables. The book is an excellent text and reference book for the apprentice machinist.

Microscopic Examination of the Ore Minerals. By W. Myron Davy and C. Mason Farnham. Pp. 150, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

The principal part of the book is a systematically arranged set of 'Determinative Tables' designed to enable the student to apply a standard set of tests to all the minerals present in a section under observation in a metallographic microscope. The classification is based upon the action of a few common reagents upon the minerals. The chapters deal with the following: Preparation of the specimen for examination; photo-micrography of polished sections; the use of the tables; and supplementary tests. The latter discussed the older methods of determinative mineralogy. The work has been confined to minerals of comparatively common occurrence, with the idea of avoiding unnecessary complication. The use of the reflecting microscope as a means for determining the identity of minerals is a development of the last 15 years, but it has received wide attention, and the present book, the authors of which have had the advantage of comparison with former works, is probably the best so far published.

Electric Furnaces in the Iron and Steel Industry. By W. Rodenhauser, J. Schoenawa, and C. H. Vom Baur. Third edition. Pp. 444. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$4.50.

The rapid progress being made in the electric-furnace industry is indicated by the fact that a third edition of this book has become necessary in less than three years from the date of the appearance of the second edition. The principal changes and additions relate to the field of practice, such as descriptions of the newer types of furnaces and the inclusion of considerable new cost and other operating data. The new edition follows the same general lines as the preceding ones. After a brief historical chapter tracing the early developments in the industry, the fundamental phenomena of electricity affecting the electric furnace are discussed. Arc-furnaces in general are then considered, after which are several chapters discussing, in turn, the Stassano, Heroult, Girod, and Rennerfelt furnaces. Similarly, a chapter is given to the induction-furnace, followed by chapters relating to the Kjellin and the Rochling-Rodenhauer furnaces. Then comes a chapter on electric-shaft furnaces, and one discussing various other arc and induction furnaces, including the Chapelet, Keller, Nathasius, Gin, Schneider-Creusot, Gronwall, Lindblad & Stalhane, Greaves-Elchells, Snyder, Greene, Hiorth, Moore, Booth-Hall, Vom Baur, and Ludlum types. This completes Part I. Part II begins by considering the materials of furnace construction, principally refractory linings. Then follows a general discussion of costs of operation, including considerable specific data on actual operation. The remainder of the book is devoted to the electro-metallurgy of iron and steel and treats, in turn, the electric smelting of iron ores and the use of the electric furnace for melting, for the refining of pig-iron, and for the production of ordinary and special-quality steel. This edition, like the preceding ones, ranks among the best treatises on the subject, and it will be needed by everyone engaged in the industry.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MAY 1, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL

	Page
NOTES	625

THE GOLD BOUNTY	626
-----------------------	-----

Comment on the McFadden bill for levying an excise of \$10 on gold in manufactures and for creating a fund wherewith to pay \$10 per ounce on gold newly mined in the United States. Mr. Vanderbilt's opinion. The needs of the gold-mining industry. Protection of the gold reserve.

THE DOLLY VARDEN	627
------------------------	-----

The story of this enterprise and comment on Mr. Taylor's article. Relations of the Goldfield Consolidated, Granby, and Temiskaming companies to the Dolly Varden Mines Co. Mr. Hubbard's and Mr. Errington's negotiations. Reports by Mr. Kaeding and other engineers. Ore-reserves in the mine. Probable litigation.

THE STRIKE AT BUTTE	628
---------------------------	-----

Conditions in Montana. Action of the radical element. Demands by the I. W. W. faction.

DISCUSSION

ADVICE TO STUDENTS

By A. T. Parsons	629
------------------------	-----

Reference to Mr. MacNaughton's address. Specialized v. liberal education. Some advantages of hard work.

COMBINATION METHOD OF MINE SAMPLING

By S. F. Shaw	629
---------------------	-----

Commendation for the method. Some examples. The factor of error.

ARTICLES

THE STORY OF THE DOLLY VARDEN MINE

By A. J. T. Taylor	631
--------------------------	-----

The discovery by Ole Evindsen in 1912. His dream. The Dolly Varden Railway Act 1917.

Financial difficulties start. Taylor Engineering Co. Report of the special committee to the legislature. Its findings. The Taylor company takes possession. Development to date.

TECHNICAL WRITING: JARGON

By T. A. Rickard	640
------------------------	-----

The use of circumlocution. Jargon is rampant in technical publications. Illustrations—and suggestions for improvement. Be concise!

WAR MINERALS RELIEF CLAIMS

The report of the Committee on Mines and Mining on H. R. 13,091, providing for a review for dissatisfied claimants.

THE FUTURE OF CHROMITE IN THE UNITED STATES

By Samuel H. Dolbear	645
----------------------------	-----

Stimulation of the industry since 1915. The reaction. Proposed tariff. National security. A survey of resources.

ARIZONA'S OLDEST COPPER MINE

By F. Le Roi Thurmond	647
-----------------------------	-----

The Planet mine near Swansea. Operated in 1865. An early-day smelter.

THE MCFADDEN BILL

A tax on gold used in industry. To be collected from manufacturers and dealers. Certain exemptions. Future readjustment. Premium for gold, newly mined. Verification of statements. Penalties.

NOTES

SECONDARY METALS	650
------------------------	-----

DEPARTMENTS

REVIEW OF MINING	651
------------------------	-----

THE MINING SUMMARY	657
--------------------------	-----

PERSONAL	658
----------------	-----

THE METAL MARKET	659
------------------------	-----

EASTERN METAL MARKET	660
----------------------------	-----


INDUSTRIAL PROGRESS	661
---------------------------	-----

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union, 25s. or \$6.

ELECTRICAL SUPPLIES *for the* **MINE, MILL & SMELTER**



EVERYDAY needs as well as special equipment of all sorts make up the Massco Electrical Line. Down to the smallest detail of mine operation, there's nothing missing.

Massco Service is a Complete Service

Rely on Massco for everything electrical and you are assured of dependable goods at right prices. Isn't it worth while to concentrate purchases and secure the benefit of a service that embraces *all* your needs even to the smallest electrical requirement.

Massco Electrical Catalog No. 56
Sent on Request

The Mine & Smelter Supply Co.

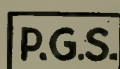
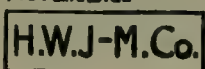
Denver

Salt Lake City

El Paso

New York Office: 42 Broadway

AGENTS FOR
THESE ELECTRICAL MANUFACTURERS





T. A. RICKARD, . . . Editor

MEASURES for giving proper effect to the War Minerals Relief act are still in hand. On page 639 we publish the text of the recommendations made by the Committee on Mines and Mining of the House of Representatives with a view to expediting the award to claimants. We shall revert to this subject next week.

STRIKES in 1919 are estimated to have caused a loss of \$723,478,000 in wages and a further industrial loss, not to labor, of \$1,266,357,000. This happened at a time when the wage-earners were receiving the highest payment and incurring the most extravagant expenditures. But the loss in money does not measure the damage; the damage done to democratic institutions and to the orderly progress of this republic is incalculable.

GOLD remains at a substantial premium in London, ranging at about 20%, but the South African mining companies have already been mulcted of some of their gains. The banking discount rate for telegraphic transfers on London from Johannesburg has been advanced to 6%, which absorbs about 7 shillings of the gold premium. The white miners have demanded, and have obtained, a raise in wages. It remains to be seen what toll the Union Government will take from the gold-producers.

BEFORE the services of our soldiers and sailors are compensated in a commercial way and their splendid response to duty degraded by measurement in dollars, it were well to recognize the obligation owing to those who, out of meagre savings, subscribed the money needed in the hour of national crisis. We remember that the people who bought Liberty bonds were told that these would never go below par, they were the most gilt-edged of all securities, they were as good as wheat; yet we note an advertisement in a street-car offering to lend \$46 on a \$50 bond, to be repaid at the rate of \$1 per month, which means that in a year the holder of the bond will lose \$4 on his principal and \$2 or more in interest, making him pay \$6 for a loan of \$46 on \$50 worth of Government credit.

SOME of our readers may have had difficulty, as we have had, in figuring the premium on gold in London as against dollar exchange. To them we venture to say that fine gold is valued at 84.95 shillings per ounce and the pound sterling at \$4.8665, so that when, as on April 1,

the exchange stood at \$3.93 and the price of gold in London at 105 shillings, the premium on gold was 19.09% when the premium on the dollar was \$19.24, which is near enough not to afford any margin for speculation in the selling of gold from this side the Atlantic. Another fact worth remembering is that silver quotations on the London market are made variously on 'standard', which means 925 fine, and on 'fine', which means the pure metal. The disparity between silver quotations in London and New York or San Francisco is due usually to comparing 'standard' there with 'fine' here. Moreover the British brokers quote 'spot' and 'forward', the latter allowing time for New York silver to reach London, this survival of an old custom being a reminder of the days when sellers in London were given a chance to make delivery on account of purchases in China.

THE occupation of Agua Prieta by the revolutionary forces under General P. Elias Calles has placed the mine operators of Sonora in an unpleasant predicament because they export their ore and bullion through the Mexican customs-house in that town. The collector for the Carranza government, Señor J. M. Alvarez Tostado, though dispossessed of his office, has informed the mine officials by means of advertisements in the newspapers of Douglas, Arizona, that he alone is authorized to receive the duty on shipments passing through Agua Prieta; he gives public warning that he will not recognize receipts issued by the revolutionary government, and that all payments will necessarily have to be made again. However, we understand that most of the mining companies are continuing their shipments, for which they are making settlement with the acting officials. What diplomatic representations will be necessary to persuade President Carranza and his astute advisers that the tax should not be paid a second time is a matter for guessing. Many miners have deserted the mines to join the ranks of the Calles army. This will doubtless be a pleasant diversion for them until such time as this latest revolt is ended.

FIRE is said to have destroyed the little settlement of Columbia in Tuolumne county, on April 24. This early Californian mining camp is one of many communities born during the romantic days of the first gold discoveries in the foothills of the Sierra. Gold was found there in March 1850 and a population of 6000 miners with 143 faro-banks soon enlivened this lovely spot amid the

pinewoods. At that exciting period Columbia had an ambition to become the capital of California; in late years it dwindled to a few score derelicts left by the receding tide of mining activity along that part of the Mother Lode. We remember, many years ago, stumbling upon a group of abandoned cabins in a quiet corner of Calaveras county. The only sounds were the murmur of a mountain rivulet and the hammering of a woodpecker. A couple of seedy-looking Chinese were ground-slucing where once an eager community of hopeful diggers had sought their fortune. The name of the camp survived upon a weather-beaten post. 'El Dorado' it was called. *El huomo dorado*, the gilded man! The myth of the Venezuelan wilds, where Raleigh first heard of the Indian chief that was covered with gold. 'Eldorado' has become synonymous with romantic expectation, not in mining affairs alone; so does the high expectancy of youth end in the derelict purpose of old age.

QUOTATIONS for South African mining shares have risen greatly during the last six months on account of the higher price obtained in London for the gold from the mines. For example, in January the Crown Mines company made £60,000 on an estimated premium of 22½s. per ounce of gold. During the same month the New Modderfontein made £47,000 in the same way. The premium profit, as it is called, in a year should amount to £600,000 for the Crown Mines and £470,000 for the Modderfontein, these amounts representing two-thirds of the entire nominal capital of the one and rather more than a third of the capital of the other company. It is not surprising that it is being said in London that the price of gold affords a spice of speculation to share-dealing on the South African mining market such as previously was supposed to characterize only base-metal mining shares. Even slow-witted persons have begun to understand that gold mining, like any other form of mining, is a 'speculation', not an 'investment'. The farce of measuring the resources of a gold mine to a thousand tons of ore and of appraising the shares to a shilling will be abandoned even by the most impudent of so-called experts. With premium dividends larger than normal profits, as in the case of the decadent Crown Mines, the outlook for the Rand is gorgeous. Even the excess-profit tax will remove only a film of gilt from the gingerbread, which will remain substantial and savory. The Rand was entitled to a bit of good luck and we are glad it has come at last.

HEARING of the case against the Minerals Separation company is in progress before the Federal Trade Commission. It is stated that Mr. John Ballot, the chairman of the company, admitted that the purpose of incorporating the American subsidiary company just before the United States entered the War was to gain the advantage of American law in enforcing license agreements upon American owners of mines. He admitted that about 500 American mining companies have been marked by him and his associates as infringers and that heretofore they have not been sued because of the desire not to in-

terfere with the production of the metals needed by the Allies. He emphasized the fact that the parent English company retained at least a 50% interest in the American subsidiary. At a later stage, on April 9, he defied the Commission and refused to answer questions regarding the amount of income received annually from American mining companies; and when directed by the Examiner to answer the question, he refused to do so until the Federal Courts shall have passed on the matter.

The Gold Bounty

On another page we publish the text of the bill introduced by Mr. Louis T. McFadden, of Pennsylvania, on March 22 in the House of Representatives. The purpose of this bill (H. R. 13201) is to protect the gold reserve of the United States from industrial depletion, in accordance with a resolution adopted unanimously by the American Bankers Association on October 2, 1919. Many proposals have been suggested, and have undergone careful scrutiny, with a view to accomplishing the desired result without disturbing the monetary system of the country. The McFadden bill is the outcome of an earnest effort on the part of conservative financiers, represented by the Bankers Association, and of the miners of gold, represented by the American Mining Congress, to arrive at a solution of the pressing problem. The Bill provides for an excise of \$10 per ounce on all gold used in manufactures or for other non-monetary purposes, the proceeds of this tax to be set aside for paying a bonus of \$10 on all new gold, that is, gold freshly mined. The jewelers, dentists, and other users of gold as a commodity will still be able to obtain all the metal they need at its monetary price of \$20.67 per ounce, but a tax of \$10 per ounce will be collectable on gold sold in manufactured form, not on bullion, which remains at its normal price, thereby maintaining a free gold market in the United States. The miner, on the other hand, will obtain a part of the enhancement of value that gold has undergone as a commodity, and by the receipt of a bonus of \$10 per ounce he will be encouraged to increase his production of the metal upon which our credit structure is based. It might seem more practicable to prohibit further sales of gold to the trade, but that would incite the destruction of gold coin, there being no law in the United States prohibiting the melting of coins. In 1919, it is estimated, \$8,000,000 of gold coin was melted for manufacturing purposes. In that year the gold furnished for use in manufactures and the arts in the United States was valued at \$80,337,600, as compared with the \$58,488,800 produced by the mines of the country; so that apparently \$21,848,800 more was consumed than was produced. However, the sale of old gold, in the form of plate and jewelry, to the Mint averages about \$8,500,000 per annum, rising to as much as \$19,517,345 in 1918, owing to the demand for charitable and patriotic purposes. The production of gold is decreasing, the consumption of gold in the arts and manufactures is increasing, so that in 1920 the loss to the monetary stock is expected to be at least \$25,000,000. The trend of the

jewelry trade is toward the larger production of machine-made articles, which necessitate heavier material on which to work. During the War a large number of goldsmiths migrated from Europe to New York, which is now the centre of this business, thereby intensifying the domestic consumption of gold in the arts. The demand for decorative dental work absorbs an increasing quantity of gold, and the extravagant tastes of this post-war period are stimulating a wasteful use of the metal that is needed for monetary purposes. Many causes, therefore, join in depleting the stock of metal. The miner is discouraged from any effort to find new orebodies by the continued rise in the cost of everything he uses, especially labor. In 1915 the output of gold in the United States was \$101,035,700; in 1919, it was only \$58,500,000; in 1920 it is likely to be less than \$50,000,000. Out of this total, only about 12% is obtained as a by-product in the winning of the other metals, so that the production of gold, unlike that of silver, gains but slightly from the expansion of base-metal mining. We recognize, of course, that the prosperity of an industry producing about \$50,000,000 worth of metal is of small consequence to a country having a foreign trade, for example, of 12 billion dollars, and we prefer therefore to discuss the McFadden bill not as a piece of class legislation but as a serious effort to serve the best interests of the country as a whole. The question arises, therefore, does the country need more gold? If it does, then it is as proper to stimulate our domestic production of gold, as of wheat, or pork, or sugar, or school-teachers. It is noteworthy that at the Seattle Mining Convention, Mr. Frank Vanderlip stated that an increase of our gold output would be of questionable benefit, because it would encourage the issue of more paper currency at a time when deflation was most needed in order to restore a normal ratio of prices at home and abroad. He pointed to the fact that the Federal Reserve banks are compelled by law to hold a reserve of gold not less than 40% against the notes that they put into actual circulation and therefore that an increase in their gold reserve would justify them legally in expanding their note-issue. However, an increase, say, of 50 millions in our gold production would only permit a possible increase of 20 millions in notes, which is a sum too small to affect the financial position of the country. The miner replies by pointing to the action of the British government in allowing gold to go to its logical premium in London and the consequent benefit not only to the mining industry under the British flag but also to the financial status of Great Britain itself in its dealings with its European neighbors. Normally the British dominions contribute 66% of the world's annual gold production; now that the Russian mines are idle or crippled and American production stifled by unfavorable economic conditions, it is probable that fully 80% of the world's new gold is being produced under the British flag. This will prove a source of great financial strength to Great Britain so long as the world's business is based upon the gold standard. It is, we believe, desirable, not in the interest of the gold miner alone, but in the national in-

terest, to stimulate our domestic production. If the McFadden bill will do it, it should be passed. Apparently, it will. We ask it not to help a special class of people or a special group of enterprises but to strengthen and establish the gold reserve upon which our monetary system is founded.

The Dolly Varden

The name of the heroine in 'Barnaby Rudge' has been given to a silver mine that is the talk of British Columbia. How it was discovered is related by Mr. A. J. T. Taylor in an article appearing in this issue. Mr. Taylor indeed tells the story of the enterprise from the start and explains how he, not a mining man, became involved in the legal complications that have made the Dolly Varden famous in the North-West. We can supplement his account of the affair with information from other sources. The first president of the Dolly Varden Mines Company, the late J. D. Hubbard, of Chicago, was vice-president of the Goldfield Consolidated, of Nevada, which company lent \$150,000 on a mortgage upon the Dolly Varden properties. The working capital proved insufficient, and apparently Mr. George Wingfield, the president of the Goldfield Consolidated, was unwilling to find more. Hence the troubles that ensued. In 1918 the building of the railroad, on which a profitable maintenance of output depended, was stopped and a quarrel arose with the contractors, the Taylor Engineering Company. Negotiations for the sale of the Dolly Varden to the Granby Consolidated Mining, Smelting & Power Company were terminated abruptly. This may be regarded as a misfortune, for the acquisition of the property by the Granby company would have been logical, having regard to the accessibility of its smelter at Anyox and its undoubted ability to bring the Dolly Varden enterprise to fruition. Next enters the Temiskaming Mining Company, of Ontario, in the person of Mr. Joseph Errington, a director living in California. Mr. Errington is a mining engineer. In October 1918 Mr. Taylor came to him at the Vancouver hotel and invited him to become interested in a deal for the Dolly Varden. Mr. Taylor showed him the reports made by Messrs. Henry Krumb and Carl O. Lindberg for the Dolly Varden company and by Messrs. J. A. Bancroft and E. J. Conway for the Granby company. Mr. Taylor urged haste, because he was being threatened by his creditors, who proposed to attach both his engineering works and his private property. He promised Mr. Hubbard's concurrence in the proposed deal. The price was to be \$1,000,000, of which \$150,000 was to be cash for the payment of the Taylor Engineering Company's liabilities on account of wages, which were to be settled at a discount. The terms were telegraphed to Mr. John P. Bickell, president of the Temiskaming company at Cobalt, and to Mr. Hubbard at Chicago. The latter replied that the Wingfield mortgage on the Dolly Varden would have to be satisfied before any new deal could be ratified. This obstacle appears to have been overcome and in December 1918 the Temiskaming directors approved the ar-

rangement, but as soon as the first payment was placed on deposit at Vancouver the creditors of the Taylor Engineering Company increased their demands, Hubbard and Taylor could not agree upon the amount that Taylor was to receive, and the negotiations broke down, because no clear title could be given to the Temiskaming company. As last arranged the Temiskaming was to pay \$150,000 in cash, \$250,000 was to be secured by notes, and \$500,000 was to come from 50% of the net profit earned by the mine. We have reason to know that Messrs. Hubbard and Errington did not stipulate for a commission, as stated in the report of the legislative committee, but that when negotiations apparently had been satisfactorily concluded Mr. Hubbard's directors offered him \$25,000 for his trouble and expenses, whereupon the Temiskaming directors followed suit, voting a similar bonus to Mr. Errington. This was embodied in the contract and was subject to the mine proving profitable. The failure of the negotiations and the worries incidental to them affected the health of Mr. Hubbard. He died last summer. Then came the enactment by the legislature of British Columbia, in itself a most extraordinary interference with a private quarrel between citizens, excusable only on the ground that the railroad to the Dolly Varden was being built by the Taylor company under charter from the Provincial government. The Dolly Varden company, of course, has brought suit against both Mr. Taylor and the Government of British Columbia, and the issue will be left to the courts, because on April 11 the Federal Department of Justice at Ottawa refused to disallow the Dolly Varden Mines Railway Act of March 28, 1919.

It remains to say that we have seen the report made by Mr. C. D. Kaeding, in January 1919, for the Temiskaming company. Mr. Kaeding is manager for the Dome Mines Company at Porcupine and an engineer of high repute. The Dolly Varden mine had been diamond-drilled and sampled by previous appraisers, whose reports were available. Mr. Kaeding found 38,590 tons of 22-oz. ore in the Dolly Varden and 50,000 tons of 15-oz. ore in the Wolf property, making a total of 1,601,854 ounces of silver in reserve. He estimated the working cost at \$6.10 per ton, so that a profit of \$900,000 seemed assured. The natural market for this ore is the smelter at Anyox, which needs it to mix with the ore from the Hidden Creek mine of the Granby company. This company in June 1918 made an agreement to smelt Dolly Varden ore, up to 400 tons daily, at \$1.50 per ton, returning 95% of the gross silver contents. The silicious flux needed at Anyox is costing the Granby about \$3.50 per ton, and it carries no appreciable precious-metal contents, so that the function of the Dolly Varden in this respect is quite plain. It is estimated that quartz containing two ounces of silver per ton could be landed at the wharf for \$2 per ton. Another available market is at Tacoma, but it would be more natural to smelt and refine the Dolly Varden output in British Columbia itself. The silver occurs mostly as argentite, but also as proustite and native metal, with galena, zinc-blende, and rhodochrosite, in a quartzose sheer-zone in andesite. The mine is full of

promise but it needs capital and experienced management. Mr. Taylor is to be complimented upon his courageous effort to develop the enterprise and we hope that he will succeed in so adjusting the conflicting interests that a well-organized company with plenty of money and skilful management will be enabled to pull the Dolly Varden out of its troubles, financial and legal, into a position of assured productiveness and prosperity.

The Strike at Butte

Operation of the mines at Butte is at a complete standstill in consequence of the strike called on April 18 by the Metal Mine Workers Union No. 800 of the I. W. W. It is 14 months since the last strike of underground workers, although the metal-trades craftsmen were out for three months last summer. Following their usual custom, the radicals first called the strike and then made known their demands through the columns of the 'Bulletin', a local newspaper devoted to the 'interests' of the workingman. These demands include the release of "class-war prisoners", the abolition of the 'rustling-card', the placing of two men on a machine, the establishment of a six-hour shift 'from collar to collar', and of a \$7-wage scale. All but the last of these are stock 'demands' and are not real issues. Naturally, the men want the rate of day's pay fixed as high as possible, but they would maintain the same attitude if \$7 were granted. Moreover, it is significant that practically all work at Butte has been done on contract or bonus for the past eight months and the average miner, with the exercise of reasonable diligence, has earned regularly \$7 to \$8, and many have done much better. It seems clear that this is simply another outbreak following the stereotyped I. W. W. formula, namely, the strike is the effective weapon in the 'class-war' struggle and as such it should be used wherever and whenever the miners are financially able to stop work for a time. Their grievance is a standing one. The unfortunate part is that while only a small proportion of the employees are actively in favor of the strike, the work of all ceases. One comparatively small group of radicals agitates at intervals, makes trouble habitually, calls strikes recurrently, and does the picketing. Non-citizens of Finnish, Irish, and Balkan extraction are prominent in this group. A second, and generally the largest, class is composed of those who are not in sympathy with the strike, but who recognize the cardinal principle that it is discreditable to work on any job where some of the employees are on strike. They do not even consider the merits of the question involved. In a third group are those who, being satisfied, resent the attempt to interfere with their efforts to earn a livelihood and continue their work if they are given protection. However, even these men do not feel that their job is worth the risk of a broken head and the result is that a small minority of workers is able to force the suspension of all industry. A similar strike at Tonopah during the past week was settled promptly, the better element being in the majority.

DISCUSSION



Advice to Students

The Editor:

Sir—Mr. McDonald's summary of Mr. MacNaughton's address before the students of the Michigan College of Mines, together with the editorial comment thereon, appearing in your issue of April 17, are full of interest to any of us that went through the mill of a technical school, whether we came out chaff or something else.

Without the full text of Mr. MacNaughton's address it is impossible to determine just what he meant by specialization. To take his own illustration, however, I do not believe that his brass-bed manufacturer confined his studies to 'bed-ology' while he was in college. I am inclined rather to believe he mastered the fundamentals of metallurgy (perhaps specializing on brass-foundry practice in his senior year), and that he studied economics, psychology, interior decorating, and many other subjects. I further believe that after leaving college he continued to keep track of the progress being made along all of these lines, irrespective of whether or not he could see any immediate definite connection with the subject of beds, and that if world conditions should alter so as to destroy the demand for brass-beds, he would have foreseen such a change long enough to convert his factory to making iron beds, or, possibly even something else than beds, before the bottom dropped out of the market for his former product. If he really thought of nothing but beds, while he might have been a good man for a subordinate position, he must inevitably have failed at the head of the industry.

Abandoning the parable, however, the specialization that, I believe, has been, and is, an evil in our engineering colleges, is largely due to the impatience of many an undergraduate with anything that does not seem to be connected directly with getting a job when he leaves college. If he only realized it, not only is a certain amount of the 'humanities' just as essential as the more technical subjects to his attaining the greater usefulness as an engineer, but also he can be by no means sure that even the specialized technical subjects will prove to be of practical value to him. The undergraduate cannot read the future any more than the rest of us. Every engineer knows men that, educated in one branch of engineering, practised it for only a short time or not at all, and subsequently attained success in some other branch or in some calling only indirectly related to engineering. Yet all of these men were helped by study of the cultural subjects, or would have been if they had had it.

This same 'economic urge' is also a contributing factor

in the desire for such positions as chemist or surveyor, too often, as you have pointed out, 'blind-alley jobs'. It is true that 'a man must eat', but the recent graduate has seldom more than himself to support, and if he cannot do that anywhere, a college education was wasted on him. Furthermore, if the girl is worth while she will wait for him. Perhaps the changes of the past few years that have increased the pay of the unskilled and semi-skilled laborer a great deal and that of the minor technical employee little or none at all, will attract the young graduate to many 'jobs', such as tramming, where a man may often learn more than in a 'position' such as that of a chemist.

Probably the principal advantage of the jobs requiring hard muscular effort as compared with those where the hands can be kept fairly soft, is not the greater opportunities for acquiring technical information, although this often happens, so much as greater opportunities for learning how to handle men. Even when he has the best of intentions, the man of education who has always 'had everything' can seldom appreciate the 'rough-neck's' point of view. On the other hand, the self-made man that has fought his way up from the ranks too often has no consideration for the men he left behind him on the way. The best material for a real 'captain of industry' is to be found in the technically-trained man that has worked his way up through the hard jobs as well as the nominally easy ones. We shall need him in the future even more than in the past.

A. T. PARSONS.

San Francisco, April 21.

Combination Method of Mine Sampling

The Editor:

Sir—In your issue of February 28 Mr. Morton Webber gives details of the combination method of mine sampling. This is interesting. It is undoubtedly on the safe side to take some large samples and ship to a mill in order to arrive at a factor that can be employed to check the groove-samples taken in the mine. That it is almost always necessary to employ a sampling factor is my experience. Such a factor obtained by comparing large shipments with groove-samples is the best that can be obtained under the circumstances; the best under any circumstances is that obtained by comparing the results of the extraction of the orebody as a whole with the samples obtained during an examination. I have had occasion in several instances to utilize the combination method in both ways mentioned above, and possibly

some notes on these comparisons will be of interest.

Case I. A gold mine was sampled which had several veins, the assays ranging from \$1 to \$100 in gold per ton. The gangue was quartz. Some sulphides were present, possibly up to 5%. Samples during the examination were taken about 5 ft. apart, and in instances where it appeared advisable, samples were cut between the 5-ft. sections. No samples were rejected. During operations, the ore was sampled as it was being delivered in the mine-cars to the mill-bin. Samples were taken from the stamp-batteries, and finally the total contents were estimated by combining the bullion returns with the tailing. The average assay of car-samples was compared with gold in the bullion plus that in the tailing during a period of about six months. This checked almost exactly. The gold content as thus determined was about 10% lower than the results from the groove-samples. No new orebodies were encountered during the period of this run, therefore no adjustment of the original mine-sampling was necessary.

Case II. Groove-samples and samples taken by drilling holes in a hard sulphide with stoping machines were compared with a large number of car-samples. The range of assay was between 5 and 50 oz. silver. The groove-samples assayed 25% more than the car-samples. These, over a period of one year, checked closely with the smelter liquidations.

Case III. Investigation was made of a copper deposit where the assay of the ore from the mine fell considerably below the smelter returns. The ore was a hard cupriferous pyrite, occurring as lenses in schist, and, as estimated from groove-samples, was supposed to assay about 3.0% copper. The ore passed through a crusher, then a trommel with holes of $\frac{1}{2}$ in. diam., the fine going to the dump as reject, the coarse going to a sorting-belt, where waste, low-grade copper, and shipping-grade products were made. All of these products were sampled and weights determined for two months. The groove-samples were found to be more than 30% higher than the returns from the ore shipped to the smelter, after having made proper allowance for the waste products sorted out.

Case IV. A copper mine was being worked in which there was supposed to be a certain tonnage of 4% copper ore, as estimated from the assay-map. This ore was rather soft and contained oxides, carbonates, and sulphate of copper, as well as copper sulphide. The mine was re-sampled, and the assays checked within about 5% of the first sampling. The ore was mined carefully and as shipped assayed 4% copper, but only after sorting out 30% of material assaying about 1% copper.

Case V. Some dumps containing several hundred thousand tons of silver were sampled by sinking pits, and cutting down the pit samples in sections of 5 ft. each. The entire rejects were also sent to a smelter sampling-mill, the comparative results in ounces of silver being as follows:

	Dump A	Dump B	Dump C	Dump D	Dump E
	oz.	oz.	oz.	oz.	oz.
Quartered samples	7.0	9.8	10.9	11.7	6.6
30-ton car-samples	7.0	7.2	10.1	10.4	5.5

The sampling factor on the above assays ranges from

0 to 26.5%, the average factor for the total tonnage in the dumps being 11.4%.

Case VI. A dump containing about 100,000 tons was sampled by sinking pits to the bottom of the dump, and taking samples from each 10-ft. section. Assays on the cut and quartered samples in comparison with assays on carload shipments were as 16 oz. silver to 12.5 oz. silver, the sampling factor in this case being 22%.

Case VII. Some dumps of silver ore containing approximately 60,000 tons may be mentioned where sampling of the dumps compared as follows, with assay results from liquidations from the shipments of these dumps to the smelters:

	Dump A	Dump B	Dump C	Dump D	Dump E
	oz.	oz.	oz.	oz.	oz.
Sample assays	14.6	15.5	17.5	12.2	12.3
Shipments	11.5	15.2	14.4	12.7	14.4

Case VIII. A mine was sampled and was estimated to contain 20,000 tons of ore. Before the mine was exhausted there was shipped some 90,000 tons. The assays of the first sampling; of the first shipments of 27,000 tons and of the entire shipments of 90,000 tons, were as follows:

	Gold	Silver	Lead	Insol.	Iron	Lime
	oz.	oz.	%	%	%	%
Mine sampling of 20,000 tons	0.63	5.4	14.2	21.1	24.1	4.3
Shipments, 27,000 tons ..	0.37	5.9	11.9	25.1	21.2	4.4
Shipments, 90,000 tons ..	0.31	6.9	9.8	23.7	23.5	4.9

In attempting to compare estimates derived from mine sampling with actual production, it is necessary to bear in mind that extensions of the original orebodies may have been followed and mined; also that increased or decreased prices for metals may have increased or decreased the quantity of ore mined with reference to the estimate. The 'porphyry coppers' are striking examples of this. It also sometimes happens that the ore becomes unavoidably diluted with waste or low-grade material, and this must be carefully considered in making comparisons.

S. F. SHAW.

Charcas, Mexico, April 18.

IT IS THOUGHT that the present Chinese mining laws requiring the Chinese majority ownership of mines are not likely to prove a serious embarrassment to American investors, as the Government will undoubtedly grant special charters to American corporations desiring to exploit Chinese mines provided the Chinese see that they will profit by such arrangements. The method most favored in such charters is for the Chinese to be given a minority interest in the corporations, paying for their stock with the property, while the actual cash received from American investors would be used for the development.

THE chrome-ore deposits of the Smyrna Vilayet contain from 40 to 55% of chromic oxide. The annual production, which has fallen off, formerly reached 7000 to 10,000 tons, although proper economic management might produce 50,000 or more tons.

INCLUDING the production of Alsace-Lorraine, France now stands second in the amount of its iron and steel production, being exceeded only by the United States.



THE CAMP AT THE DOLLY VARDEN MINE

The Story of the Dolly Varden Mine

By A. J. T. TAYLOR

The Dolly Varden mine and the railway bearing the same name have been before the public since the fall of 1918, owing, first, to the dispute between the original owners, the Dolly Varden Mines Company of Chicago, and the Taylor Engineering Company of Vancouver, which resulted in special legislation at the last session of the Provincial Parliament of British Columbia and a transfer of the property from the Dolly Varden company first to the Taylor Engineering Company and from it to the present owner, the Taylor Mining Company Limited, and, second, to the fact that since the first of September 1919 the property has produced nearly five hundred thousand ounces of silver. The purpose of this article is to give a history of the property and a brief account of the vicissitudes that brought about the change of ownership.

The Dolly Varden is situated in the Portland Canal district of British Columbia, 18 miles from the Granby Consolidated Company's Hidden Creek mine and Anyox smelter. The claims themselves are 17 miles up the Kitsault river at the head of Alice Arm, Observatory Inlet, in the Skeena mining division, at an altitude of 1700 ft. The Dolly Varden railway parallels the Kitsault canyon from the mine to Alice Arm, and is the only means of local transport.

The discovery was made in 1914, on a projecting outcrop some 40 ft. wide, by a prospector, Ole Evindsen, now the proprietor of the Alice Arm hotel. Ole is not the pioneer prospector in the Alice Arm district. This distinction goes to Tom Stark, whose proud boast is that he "was the first white man in that country". The authentic history of the discovery of the property and the naming of the mine has been taken by me direct from Mr. Evindsen and is interesting enough to recount in full.

"I had heard talk of mineral wealth, so I left Prince Rupert and came up here with three other chaps in the

spring of 1912. We packed in grub and set out up the Kitsault river. None of us had been up there before, but we were hoping to find some good claims. One night just after we started, one of the chaps, Ole Pearson, had a dream. His uncle had died a few months before. Ole told us that his uncle had come to him in a dream the night before and had showed him a big white boulder and some rocks and said: 'You are going to find a big mine, which will make you rich so that you will not need to work for the rest of your life. You will go on until you find this boulder and these rocks and then you must stake the claim and the name you must give it is the Dolly Varden claim.' "

When Ole Pearson told his dream next morning his companions received it with amused interest and hope. Days passed as the little company fought their way up through the dangerous canyon without sight of mineral. Then two of the company went back for supplies, while Ole Evindsen and his companion Pearson struggled on.

"We took different paths about 75 yards apart. I took the higher ground to prospect," said Evindsen. "Then I saw in the bare andesite a streak of gray rock that looked like it carried silver. With my hammer I broke down the capping of the rock and saw that I had uncovered a vein that looked like very rich silver ore."

While Evindsen was examining his new find Ole Pearson let out a yell, "I've found the mine; I've found the mine," he cried in great excitement.

"I've found one too; stay where you are," called back Evindsen, who, as the more experienced prospector, finished his search before lowering himself down to where Pearson was waiting.

"Where's your mineral?" asked Evindsen, as he handed his own samples over to Pearson and looked around for signs of a vein or lode.

"I haven't found any mineral, but here's the boulder that my uncle showed me in my dream; and here's the

rocks and the river and the trees and everything exactly as my uncle showed me in my dream," insisted Pearson.

What with Evindsen's vein and Ole Pearson's boulder, the two prospectors concluded that the finger of Fate was clearly pointing their way. They started to stake their claim and make arrangements to record it. "Say, what is the name your uncle said we were to call the claim?" asked Evindsen. "Hanged if I can remember," admitted Ole Pearson at last, after vainly trying to cudgel his brain. So far as Evindsen was concerned the name had slipped his memory. All that day and all the next day the two lone prospectors sat around trying to think up that elusive name, feeling that they could not afford to take chances on any other. At last hope came. The two companions hove in sight with the grub. Without disclosing their find Ole Evindsen put the fateful question: "What was the name of that claim that Ole Pearson's uncle told him?" A moment's pause and then the answer came: "It was the Dolly Varden."

Since then the original Dolly Varden property has been enlarged by later locations, so that there is now the Dolly Varden No. 1, the Dolly Varden No. 2, and so on, up to eight claims.

"How do you account for Ole Pearson getting that name 'Dolly Varden' in his dream?" I asked. Ole Evindsen pulled at his pipe and spoke reflectively. "I have tried to think that out," he said, "and I think I know where it came from. There was a book in the camp that we all used to take up and read now and then, and I see that it tells about Dolly Varden, the actress, in it. We all used to take a turn at the book and I think Ole Pearson must have read the name and it came back to him in his dream." He anticipated the next question by adding: "But the thing that puzzles me is that boulder and those rocks, just as Ole's uncle showed him in the dream. None of us had ever been up into that country before, and Ole says that everything is just exactly as he saw it in the dream. And she's turned out to be a mine just as the dream said," he added.

In 1914 R. B. McGinnis of San Francisco took a bond on the Dolly Varden group from Evindsen, and a similar bond on the Wolf group, two miles farther up the canyon, from the original locator, Donald W. Cameron. Early in 1916 Mr. McGinnis re-bonded both properties to the Dolly Varden Mines Company of Chicago, organized under the laws of the State of Delaware by the late J. D. Hubbard.

Mr. McGinnis explored the property by extensive tunneling and diamond-drilling, and thereupon exercised the option on both the Dolly Varden and the Wolf claims. At the outset the Dolly Varden company proposed to build a concentrator at the mine and to ship the concentrate over a trail that it proceeded to construct from the mine to Alice Arm. In the fall of 1916 the company found that the trail would not be adequate for its purposes, and in 1917 it applied to the Legislature for a charter to build a narrow-gauge railroad connecting the mine with tidewater. This was granted under the Dolly Varden Railway Act 1917, the terms of which required the company to complete a narrow-gauge

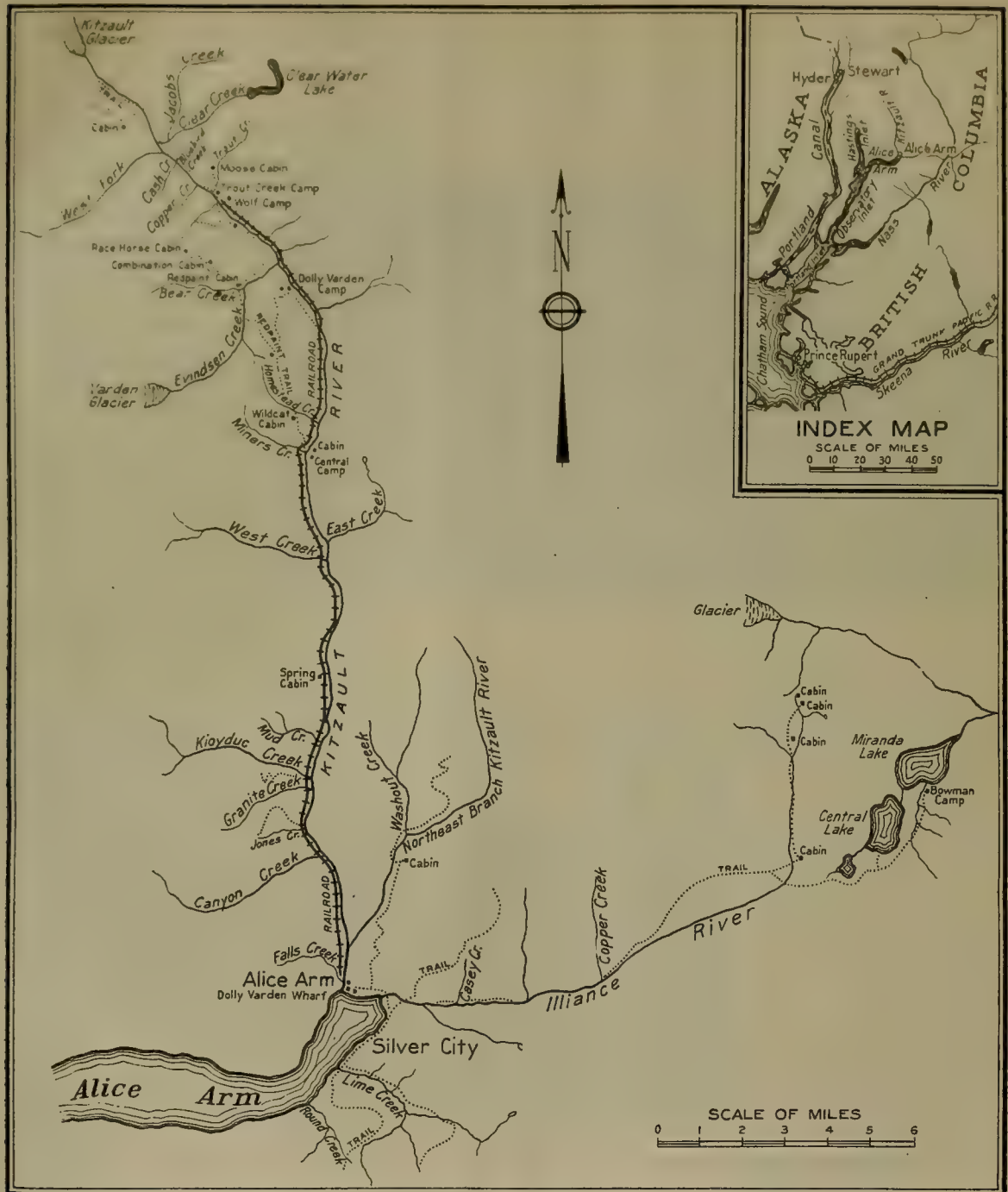
railway from Alice Arm to the Wolf mine by December 1918, in default of which the charter became null and void.

After the passage of the Act by the legislature of British Columbia, the company employed the Taylor Engineering Company to build the railway on the basis of cost plus a percentage, and in its desire for a speedy completion of the road the company desired the work to proceed without full surveys and profiles. Although the first few miles was easy, the construction at the upper end through the canyon of Kitsault river proved exceedingly difficult and expensive. Portions that the mining company's preliminary survey had shown to be grassy slopes proved to be moss-covered rock, while the last several miles of the road involved heavy rock-cutting and necessitated many bridges and trestles.

The close of 1917 found the railway uncompleted, owing to the difficulties of construction, labor troubles, and steamship strikes, the net result of which was that the road cost more than was anticipated and the Dolly Varden company was unable to realize on the ore that it had ready for shipment. In the spring of 1918 the Dolly Varden company entered into negotiations for the sale of the property to the Granby Consolidated Mining, Smelting & Power Co. The Taylor Engineering Company carried on the construction of the road for some time on its own capital, the details of which arrangement are set forth at length elsewhere in this article. Toward the end of the season of 1918 the Dolly Varden company terminated negotiations with the Granby company and denied all liability to the Taylor company for the work done. This unexpected turn of events forced the Taylor company to make an assignment for the benefit of its creditors in October 1918.

Much hardship ensued. Workmen with claims totaling \$150,000 were left unprovided, and members of the mine and engineering staff were threatened with violence. The creditors of the Taylor company made A. J. T. Taylor, president of that company, assignee in charge of its affairs, and Mr. Taylor in his efforts to avert a collapse of the undertakings of his company, and with the permission of Mr. Hubbard, interested the Temiskaming Mining Company of Ontario in a proposal to buy the property on terms that would have allowed all claimants to be paid in full. After these preliminary negotiations the Dolly Varden company entered into a contract with the Temiskaming company to sell the Dolly Varden and Wolf claims and railway, without departing from the stand that the Dolly Varden company had taken that it had no liability for the 1918 construction by the Taylor Engineering Company.

As the limit of time under the special Act of 1917 had expired, it became necessary for the Dolly Varden company to obtain from the Legislature an extension of time for construction of the railway in order to complete the sales contract with the Temiskaming company. The petition to the Legislature for a renewal of the railway charter was met by a cross petition from Mr. Taylor on behalf of the general creditors, asking that no renewal be granted except upon such terms as would protect all



MAP OF THE PORTLAND CANAL MINING DISTRICT, BRITISH COLUMBIA

the creditors. A special committee was appointed by John Oliver, the Premier of British Columbia, to hear all parties and report to the Legislature. The report was submitted by David Whiteside, chairman of the committee. He stated the matter in dispute thus:

"The dispute between these two companies comes before the Legislature in the form of a petition by the Dolly Varden Mines Company for an extension of the

time given to it under the 'Dolly Varden Mines Railway Act' of 1917 in which to complete the construction of the Dolly Varden Mines railroad, and a cross-petition by the Taylor Engineering Company, Limited, contractors for the construction of the road, praying that such a renewal of the Dolly Varden Mines railroad charter be not granted except upon such terms as shall constitute their claim for the unpaid balance of the charge for con-

struction, amounting to approximately \$462,500, as a lien upon the assets of the Dolly Varden Mines Company."

Describing the work on the railroad, the report proceeds to say:

"At the outset a light dinkey road was required, following the path of an existing pack-trail with capacity to haul out daily 30 tons of ore or concentrate. The Mining Company, in its desire to have the road completed and the mine operating before the close of the year 1917, desired that the work should proceed at once without the delay involved in having the usual surveys made and quantities calculated. The Taylor Engineering Company accepted the contract on a cost plus 10% basis. A written agreement that the work would not cost more than \$175,000 was given by the Taylor Engineering Company. This agreement, however, was, according to the evidence of Mr. Taylor, supplemented by a private verbal agreement whereby President Hubbard, of the Mining Company agreed to see that any excess above this figure up to an extra \$100,000 would be paid.

"After the road was commenced, labor difficulties, the increased cost of materials, improved standards of construction required, and unexpected difficulties in engineering resulted in an expenditure during the first season of over \$275,000 without the road being nearly completed. Mr. Hubbard observed the private agreement he had made to the extent of paying the contractor \$70,000 out of the extra cost of \$100,000, and work was stopped on the construction owing to lack of funds. Up to this point there is nothing in the relation of the two companies which calls for adjudication on the part of your committee.

"The present dispute arises out of the operations for the year 1918. Mr. Taylor was very anxious to complete the construction of the road. At the same time the shareholders of the Dolly Varden Mines Company, through Mr. Hubbard, were endeavoring to negotiate a sale of the property to the Granby Consolidated Mining, Smelting & Power Company. Mr. Hubbard represented to Mr. Taylor that the Dolly Varden company was unable to assume any financial responsibility for further work done upon the road, but assured Mr. Taylor that if he desired to go on at his own risk he would be fully paid in the event of the sale to the Granby company being made. In the event of the sale to the Granby company not being made, Mr. Hubbard stated that so long as the work was done to the satisfaction of the engineers of the Dolly Varden company, the Taylor company would have all its just claims paid and be given proper compensation for engineering and contractor's profits out of any subsequent disposition of the mine."

The letter from Mr. Hubbard to Mr. Taylor, dated May 14, 1918, is as follows:

Vancouver, B. C., May 14, 1918.

Gentlemen, I understand that you have proposed to Mr. Sylvester,* of the Granby Company, that the Taylor

Engineering Company should resume construction of the Dolly Varden railroad and carry it on pending the examination of the Dolly Varden properties by the Granby Company; that if the Granby Company should elect to exercise its option and purchase the Dolly Varden properties, the Granby Company would reimburse the Taylor Engineering Company for the outlay and make satisfactory arrangements with you for the completion of the road. I understand that Mr. Sylvester has indicated a willingness to accept your offer.

We are not concerned with any arrangement you may make with Mr. Sylvester in regard to the matter, provided the Granby does ultimately take the properties over; but in case they should not do so, it is obvious that your relations with the present owners of the property would become important and would require serious consideration.

You are already fully informed of the limitations and conditions affecting the ownership and the policy of the owners at this time, and this knowledge will enable you to readily understand the position which I am compelled to take.

The owners cannot and will not assume any liability whatsoever at this time. They will recognize neither a financial nor a moral responsibility to reimburse you, or to compensate you for this work in case the Granby Company does not buy the properties. They cannot and will not permit the properties to become subject to any lien for material, labor, or other charges. If the Taylor Engineering Company undertakes this work it will be necessary to have from them an instrument releasing the present owners from any financial or moral responsibility in the matter, and expressly waiving lien rights and protecting the property against such rights, not only as to the Taylor Engineering Company, but as to sub-contractors and material men.

As against this, you can rely upon the following facts and assurances: If the Granby Company should not exercise its option to take over the properties, it is obvious that the present owners will either have to re-organize, complete the railway, and operate the properties themselves, or dispose of them to some purchaser other than the Granby Company. In either event, and subject to the limitations stated below, I will personally assure you that any just claims you might have for the work done and materials furnished will be recognized and provided for either in case of re-organization or sale to others. Compensation for such claims would include not only a reimbursement, but proper compensation for engineering and contractor's profits. This assurance, however, presupposes that all work shall be done to the satisfaction of the owners, and will have to be approved by their engineers, who would be the sole judges as to whether and how far the work would be acceptable.

You may safely assume that the Dolly Varden properties with the railway constitute an asset of sufficient value to justify the assumption that any just claim you might have could and would be taken care of in the final 'work-out' of the proposition and in any event. A final payment of \$25,000 is due on October 1st next on the Wolf claims and the Goldfield Consolidated Mines Company loaned \$150,000 at 6%, which is due January 1, 1919, and for which the Goldfield Consolidated Company is entitled to a mortgage. This mortgage has not yet been recorded and its final form is yet to be agreed upon. I cannot personally guarantee it, but I have no doubt the payment on the Wolf claims will be made when due. In spite of the statement, the owners will not and cannot consider any arrangement which might create a lien upon the property, in case of foreclosure of the Goldfield mortgage, and failure to redeem by the present

*F. M. Sylvester, vice-president, and managing director at Vancouver.

owners, arrangements could and would be made whereby you could redeem from such foreclosure.

Yours truly,

J. D. HUBBARD.

The report proceeds to say:

"Relying upon the undertaking given in the latter paragraph of Mr. Hubbard's letter, the Taylor Engineering Company resumed construction-work in 1918. All parties were at that time expecting the sale to the Granby company to be carried out, and the work upon the road was done to conform to the requirements of the Granby company,† which required a roadbed of increased width with easier curves and capable of handling 400 tons of ore daily. This work was done, as the correspondence shows, under the supervision of R. B. McGinnis, resident engineer for the Dolly Varden company.

"The work was carried on in 1918 on the credit and capital of the Taylor company, which by the middle of July of that

year had to his engineer, Mr. McGinnis. On August 19, 1918, Mr. McGinnis wired to his chief, notifying him in effect that the Taylor company were at that date so far committed financially that they could not stop construction without financial ruin. On October 12 the Granby offer was refused. On October 22 construction



THE CAMP AT THE MINE



DIRECTORS AND OFFICERS OF THE COMPANY

1. A. J. T. Taylor. 2. Major D. D. Young. 3. Major A. Davis.

year was at the end of its resources. When the offer of purchase was finally made by the Granby company, it was refused by the directors of the Dolly Varden company, owing to dissatisfaction over the proposed conditions of operation. The financial embarrassment of the Taylor company was well known to Mr. Hub-

bard and the Taylor Engineering Company assigned for the benefit of its creditors.

"Since assignment Mr. Taylor, in his efforts to enable the Dolly Varden company to obtain the money wherewith to pay off his claim, succeeded in bringing Mr. Hubbard and a representative of the Temiskaming Mining Company, of Cobalt, together. Mr. Taylor endeavored to effect a sale of the Dolly Varden properties to the Temiskaming company at a price of \$1,100,000, his services as an agent in the matter being given without charge. Since then, Mr. Hubbard, of the Dolly Varden company, and Mr. Errington, representing the Temiskaming company, have arranged for

the sale of the property to the Temiskaming company at a price of \$900,000, which includes a commission of \$50,000 to be divided between Messrs. Hubbard and Errington, this sale being conditional upon the renewal of the charter to the Dolly Varden railway.

"The sum of \$900,000 is insufficient to pay all parties without loss, and your committee understands that the proposal of the Dolly Varden company, which claims to have invested \$640,000 in the property, is that the char-

†We have abbreviated the names of the various companies, in order to save space and avoid needless repetition.
—Editor.

ter for the railroad be extended on condition that they pay in full the wage-claims for the construction of the road, amounting to approximately \$150,000, and that the creditors of the Taylor company divide with them the losses on the mine and railroad project.

"It was urged by counsel for the Dolly Varden company that the president of his company, in his letter of May 14, 1918, repudiating all moral and financial liability to the contractors, had no authority to bind the company to any undertaking in the event of a sale to the Granby company not being carried out. Assuming this to be so, Mr. Hubbard having been allowed to assume the direction of the affairs of the Dolly Varden company, your committee considers that it would be unjust to allow the Dolly Varden Mines Company to divest itself of liability for the construction of the railway, especially when the company is engaged in marketing the very labor and material which was placed on their property as a result of the inducement held out by its president in his letter of May 14, 1918.

"The correspondence and evidence showed that the work in 1918 was carried out without excessive cost under the supervision of R. B. McGinnis as resident engineer of the Dolly Varden company, who reported to the president of his company on September 11, 1918 (six weeks before work stopped): 'The construction work on the road has been well done throughout, and the only complaint we could make is that they had spent more money on the upper end than we intended to at this time.' Mr. McGinnis also says in the same report to his president: 'If Granby takes the property, all right, and if we keep it we will have a good road, but have a heavier investment than was absolutely needed at the start. We could have changed the road later.'

"The evidence of the Government railway engineer who inspected the line was, however, that the road only met with the minimum requirements, was not extravagantly built, and that had it been less well built they would not have taken the responsibility of issuing the company a certificate to commence railroad operations. Your committee, therefore, being satisfied on the evidence that the work was properly performed and that the Taylor Engineering Company resumed operations in 1918 on the promises made in the letter of May 14, by J. D. Hubbard, president of the Dolly Varden company, that the Taylor company would be paid in full for its just claims, either from a sale to the Granby or 'sale to others', feels that the Taylor company is entitled to be paid in full for its 'just claims . . . for work done and materials furnished', to 'include not only a reimbursement, but proper compensation for engineering and contractor's profits', to adopt the language used by the president of the Dolly Varden company in its letter to the Taylor Engineering Company.

"Your committee points out that since the Dolly Varden company entered into the proposals to sell to the Temiskaming company for a price of \$900,000 an offer of \$1,100,000 for the property had been made by S. S. Taylor, on behalf of the creditors of the Taylor company. This offer is without the payment of commission to any-

one, and if carried into effect would enable all the creditors to be paid in full, and leave a sum larger by over \$50,000 for the shareholders of the Dolly Varden company than would be the case under the offer of the Temiskaming company.

"Your committee therefore recommends as follows:

(1) That a renewal of the charter of the Dolly Varden railway be granted to the Dolly Varden company upon compliance with the terms and conditions set out in the draft Bill annexed hereto.

(2) That if the Dolly Varden company and the Taylor company cannot agree upon the cost of construction of the railway during 1918, such cost shall be ascertained by reference to one of the Judges of the Supreme Court of British Columbia to be named by the Minister of Railways, and the cost so ascertained, together with 10% thereof added for contractor's profit, shall be declared a debt due from the Dolly Varden company to the Taylor Engineering Company.

(3) That the sum so ascertained to be due be constituted a lien or charge upon the said railway and upon all the assets of the Dolly Varden company . . . subject only to a mortgage for the sum of \$150,000 and interest in favor of Goldfield Consolidated, and to the balance of purchase-money due to Donald W. Cameron in respect of the Wolf group of mineral claims.

(4) That all wages due in respect of the construction of the railway in 1918 be paid by the Dolly Varden company within 14 days after the enactment of legislation giving effect to your committee's report.

(5) That the balance of the moneys due the Taylor company in respect of the construction of the said railway shall be paid within 30 days after the amount of the same has been so ascertained.

(6) That if the Dolly Varden company do not wish to assume the burden of the aforesaid payments to the Taylor Engineering Company, they must so notify the Minister of Railways within one week after the adoption of this report by the Legislature, in which event the Taylor company shall have the right, upon the terms and conditions hereinafter mentioned, to acquire from the Dolly Varden company the said railway and all the assets enumerated in the schedule attached to the said draft Bill, and the Dolly Varden company shall be entitled to receive from the Taylor company the amount of its investment in said assets in said schedule mentioned, such amount to be ascertained, in case of disagreement, in the same manner as the cost of construction of said railway.

(7) In the event of the Taylor company becoming entitled to acquire the said railway and other assets of the Dolly Varden company hereinbefore mentioned, the Taylor company shall pay off and discharge the said mortgage to the Goldfield Consolidated, or otherwise protect the Dolly Varden company against all claims and demands in respect of the same, and shall also pay off the balance of purchase-money due to said Cameron in respect of the Wolf group of claims mentioned in said schedule, and shall also within one week after the adoption of this report produce evidence satisfactory to the



THE RAILWAY NEAR ALICE ARM

Minister of Railways of the Taylor company's ability to complete the purchase of said assets from the Dolly Varden company.

(8) In the event of the Dolly Varden company deciding not to pay the cost of construction of the said railway, and in the event of the Taylor company acquiring and expecting the right to take over the said assets upon payment of the amount of said Dolly Varden company's investment in the same, the latter company shall be released from all claims and demands of the Taylor company in respect of the construction of said railway, and shall be entitled to be paid by the Taylor Engineering Company the amount of its investment so ascertained as aforesaid upon the terms set forth in the draft Bill submitted herewith."

Upon the Legislative Assembly receiving and adopting the report of the select committee, a bill known as the 'Dolly Varden Mines Railway Amendment Act, 1919', was passed unanimously by the Legislative Assembly on March 28, 1919. This legislation provided, first, that the time for completing the Dolly Varden railway should be extended until December 31, 1920; that the cost of construction of the railway, as ascertained by a judge of the Supreme Court of British Columbia, should be a charge on the assets of the Dolly Varden Mines Co.; that the company should have a reasonable time in which to pay off the claim of the Engineering

company, represented by the cost of the construction of the railway, and that if they did not choose to pay off this claim within the time provided in the Bill, the Taylor Engineering Co. should be under the obligation, within 14 days, of providing sufficient money to pay the unpaid wages incurred on the railway construction, and should satisfy the Minister of Railways of their ability to finance and operate the mines and railway, and upon complying with these requirements, the properties of the Dolly Varden Mines Co. should forthwith vest in the Taylor Engineering Co. as an estate in fee simple, subject to certain floating statutory charges.

These charges are set forth in detail in the Bill itself and consisted first of two that were owing by the Dolly Varden Mines Co., one a balance on the purchase price, and the other a mortgage; then a charge in favor of the Taylor Engineering Co. representing the cost of the railway construction, and lastly a charge in favor of the Dolly Varden Mines Co. representing the full amount of their investment in the mines and railway. The Bill provides that these charges shall be payable in the fixed order of priority out of the net proceeds from the operation of the mines, and it also provides that the amount of the third and fourth charges, namely the one in favor of the Taylor Engineering Co. and that in favor of the Dolly Varden Mines Co. shall be ascertained by a judge of the Supreme Court of British Columbia. These



NEAR THE MINE

amounts were fixed by agreement at \$462,000 and \$613,000 respectively.

Immediately after the Act had been passed unanimously by the Legislature, a Judge of the Supreme Court was appointed, as provided for under Clause 3, and the charge in favor of the Taylor company was fixed at \$462,628 and the charge in favor of the Dolly Varden company at \$613,000. The Dolly Varden company failed to take advantage of Clause 4 of the Act and the premises therefore vested in and became the property of the Taylor company, as specified under Clause 5, the Taylor company having complied with all the requirements of Clause 6, and within the 14 days provided for under Clause 6 had incorporated the Taylor Mining Co., with an authorized capital of \$1,500,000, and had raised \$340,000 cash with which to pay the unpaid wages for labor due on the 1918 construction, and to provide for the extension of the railway and the equipment of the mine.

THE DOLLY VARDEN PROPERTY consists of eight claims, covering 212 acres and extending from the river to the summit of the ridge between the Kitsault river and Evindsen creek. The camp and principal mine workings are about 1700 ft. above sea-level.

The orebodies occur as replacement deposits along fracture-zones in andesite. The wall-rock has been replaced by quartz, accompanied by considerable pyrite and smaller amounts of galena, sphalerite, native silver, ruby silver, argentite, and rhodochrosite. The maximum width of the lode is 30 ft., but it has not been followed continuously along the strike for more than 60 ft., as it has been faulted both before and after the deposition of the ore, the displacement apparently taking place in a north-westerly direction.

The lode has a general east and west strike and dips north at from 45° to 70°. It was first exposed by a series of cross-cuts and later by four tunnels and diamond-drilling. The development in June 1919, when the Taylor Engineering Co. came into possession, consisted of 2086 ft. of drifts and cross-cuts, 280 ft. of open-cuts, and 8990 ft. of drill-holes. A large amount of work has been done since then.

The ore-reserves estimated in June 1919 consisted of 40,500 tons of ore averaging 36.4 oz. silver. The average analysis of the ore shows:

	%
Insoluble	76.7
Silica	71.9
Iron	8.5
Lead	1.20
Zinc	0.02
Gold	0.0021
Alumina	4.1

The Wolf claims are about two miles farther up and on the opposite side of the Kitsault river. They comprise four claims covering 179 acres. The outcrops range in elevation from 420 ft. to 1780 ft. above sea-level.

The geology of the Wolf ground is similar to that of the Dolly Varden except that the veins appear to be more regular, as no displacement of any consequence occurs. The development in June 1919 consisted of 85 ft. of drifts

and cross-cuts, 772 ft. of open-cuts, and 4919 ft. of diamond-drilling.

Three veins have been exposed; they have a strike a few degrees east of north and dip 50° to 75° north-west. The width varies from 10 to 30 ft. In general the walls are well defined, and the estimated probable and possible ore in the Wolf has been placed at 120,000 tons of 15.4



MAP OF CLAIMS IN THE PORTLAND CANAL DISTRICT. THE DOLLY VARDEN PROPERTY IS MARKED BY SHADING

oz. silver and 430,000 tons of 3.1 oz., or an average of 550,000 tons of 5.7-oz. ore.

The company owns water-power rights on Trout creek, immediately adjoining the Wolf claims, from which it is estimated that an ultimate development of 2500 hp. is possible.

The Taylor Engineering Co. came into possession of the railway and mining properties on June 10, 1919, and during the season just closed they completed the railway to the mine, built a 2000-ft. aerial tramway from No. 4

tunnel to the railway grade, installed a steam-driven compressor of 550 cu. ft., equipped the mine, and commenced shipping on September 1. Between that date and the close of the railway on December 15 there was delivered to the smelters or in transit ore containing a total of 458,994 oz. of silver. The run-of-mine ore averaged 56.4 oz. per ton. During the season a deposit of native silver was uncovered that up to date has yielded something over 100,000 oz., the smelter returns from this ore ranging from 1200 to 2500 ounces.

At the present time the railway is closed down by snow, and a force of 50 men is at work at the mine, driving a low-level tunnel 230 ft. below the workings. A small amount of high-grade ore is being sacked and shipped by dog-sleighs, and a certain amount of the run-of-mine ore is being delivered over the tramway to the railway terminal to form a reserve for shipment in the spring.

War Minerals Relief Claims

The Committee on Mines and Mining, to whom was referred the bill (H. R. 13,091) providing for a review by the Court of Claims of awards to dissatisfied claimants under the war-minerals relief act, reports the same back to the House with the unanimous recommendation that the bill be passed.

The attention of the committee was first directed to this matter several months ago by the complaints of several claimants, and this bill was framed by the committee and unanimously agreed to after months of painstaking hearings, a part of which is printed.

The hearings of the committee were undertaken, not for the purpose of reviewing the findings of the War Minerals Commission, to whom the Secretary of the Interior delegated his authority under the law, but for the sole purpose of determining what additional legislation, if any, is necessary to carry out the purpose of Congress in enacting the war-minerals relief provision, which is section 5 of the informal war contracts relief act.

The committee is of the opinion that the commission erred in its interpretation of the legislative intent, its interpretation and application of the provisions of the act, and the application of the provisions of the law to the facts. The law under which claimants seek relief is said section 5 referred to and clearly and explicitly directed the Secretary of the Interior to—

*adjust, liquidate, and pay such net losses * * * and shall make adjustments and payments in each case, as he shall determine to be just and equitable * * * it shall appear to the satisfaction of the said Secretary that the expenditures so made, or the obligations so incurred by the claimant were made in good faith for and upon property which contained either manganese, chrome, pyrites, or tungsten in sufficient quantities as to be of commercial importance * * * that moneys were invested and obligations were incurred * * * in a legitimate attempt to produce * * * for the needs of the Nation for the prosecution of the war, and that no profits of any kind shall be included in the allowance of any of such claims, and*

that no investment for merely speculative purposes shall be recognized in any manner.

The language of the act as above quoted is clear, and if interpreted as the courts of the country have repeatedly held such statutes should be interpreted, the committee is of the opinion that the purpose of Congress can be fully carried out and a "just and equitable" settlement can be had of every legitimate claim. For the correct rule of interpretation and application of such a statute see *United States v. Dixon* (15 Peters), *United States v. Union Pacific Railroad Co.* (91 U. S.), *United States v. State of New York* (160 U. S.), *Smith v. Townsend* (140 U. S.), *District of Columbia v. Washington Market Co.* (108 U. S.), *McClure v. United States* (115 U. S.), *Monongahela Navigation Co. v. United States* (148 U. S.), *Stewart v. Kahn* (78 U. S.). For the reasons above stated the committee has not thought it necessary to amend the original act, but that the pending bill should be confined to giving to the dissatisfied claimants the same right that the original act gave to dissatisfied War Department informal contract claimants; that is, a review by the Court of Claims. By giving such a right to these claimants Congress will simply put them on an equal footing with the War Department claimants, as provided by section 2 of the original act of March 2, 1919.

While the committee has given consideration to the matters set out above, another consideration that moved the committee was the necessity from the standpoint of the Government and of Congress to have all of these claims finally adjudicated at a time when the facts were easily available. If this is not done, judging by the experience of the past, Congress would be called upon to consider private claims bills covering the claims of the different dissatisfied claimants; and not only from the standpoint of Congress is this to be avoided, but from the standpoint of the Government it is thought best to have these contentions finally reviewed now and finally settled.

THE PRODUCTION of asbestos in Quebec during 1919 totaled 135,861 tons, valued at \$10,932,189. This is apart from the value of the asbestic, a by-product of the asbestos mills, which gave 23,827 tons valued at \$63,011. As compared with 1918 it is an increase in value of \$1,912,290 or 21.2% and a decrease of 6514 tons or 4.6% in quantity. The quantity of rock mined and hoisted was 3,061,690 tons. Taking into consideration stocks on hand, 154,378 tons of asbestos was extracted from this ore, which corresponds to an average of 100.8 lb. valued at \$3.88 per ton of rock mined. In 1918 the average was 117.3 lb. valued at \$4.08, and 108.7 lb. valued at \$3.08 in 1917.

COPPER mining in Sweden has not been nearly so important of late years as in times past. The average yearly production for the period 1891-1895 was 23,941 tons, whereas in 1916 the output was but 1380 tons. In 1917, however, there was an increase to 13,193 tons. The principal mines are at Falun and Helsingborg. The latter, it appears, works the burnt pyrite obtained in the manufacture of sulphuric acid into copper.

Technical Writing: Jargon

By T. A. RICKARD

*The dictionary defines 'jargon' as "barbarous or debased language". This description does not suffice. Quiller-Couch has said, it is "a kind of writing which, from a superficial likeness, commonly passes for prose in these days, and by lazy folk is commonly written for prose, yet actually is not prose at all". The two main vices of jargon, he says, are "that it uses circumlocution rather than short straight speech", like the Babu who reported his mother's death by saying: "Regret to inform you, the hand that rocked the cradle has kicked the bucket." Its other chief vice is that "it habitually chooses woolly abstract nouns rather than concrete ones", like the newspaper statement, "He was conveyed to his place of residence in an intoxicated condition", instead of saying, "He was carried home drunk". Jargon is "an infirmity of speech", it is not journalese, but akin to it. "Like respectability in Chicago, jargon stalks unchecked in our midst" and renders much technical writing ridiculous. It deals in periphrasis instead of going straight to the point, it loves the abstract rather than the concrete, it dabbles in words of sound rather than meaning. Avoid it, despise it, if you purpose earnestly to write well. "In literature as in life he makes himself felt who not only calls a spade a spade but has the pluck to double spades and re-double."[†]

Jargon is rampant in technical publications. Catalogues and other advertisements are conspicuous offenders, but with these the critic is not concerned, except in so far as such 'write-ups' pretend to follow the style set by technical journals and by the transactions of technical societies. Here is an example, taken from a reputable paper:

(1) "The next proposition was to take out the rock to a depth of 20 ft. and build up an underground wall to carry the weight of the caisson and make the permanent seal to keep out all water. To avoid the possibility of jarring loose any of the temporary sealing blocks or breaking back under them the rock which was of a slaty nature, this excavation was started by channeling out for a depth of 5 ft. all around the shaft about 1 ft. inside of the blocking. The rock was then taken out in the ordinary manner with two shaft-bars and four rock-drills in operation. To further prevent the jarring of this blocking the rock was taken out in 5-ft. benches only. This made the work necessarily slower, but it was deemed advisable and so proved, for, notwithstanding the care exercised, certain leakages occurred which made the rock

excavation slow on account of the shifting of pumps, taking off and putting back suction pipes, etc. This rock, as above mentioned, was a species of sand slate which would break back a considerable distance from the line of holes."

I shall not attempt to revise it, for it needs to be re-written by one possessing the detailed information that the writer has attempted, unsuccessfully, to impart. To many it may not seem utterly bad, but it is obvious that only absolute need of the information would induce anybody to read it.

The foregoing example shows how the English language is mishandled in America; now I shall give you an example to show how our language is maltreated in the country of its origin. The following quotation is taken from a book on petroleum recently published in London.

(2) "In this vaporizer, which works efficiently with any of the refined flash-proof lamp oils, the mixture is only heated to the comparatively low temperature of 300° to 400°F., in which connection it is well to understand that the more perfectly an oil is atomized the lower is the temperature necessary to its combustion, which is an advantage, if not off-set by the necessity for a more than corresponding complexity of apparatus, which in this case, as will be seen, requires an air pump and for the fuel to be contained in a tank subject to a pressure of 8 to 15 lbs. per square inch; and this again obviously necessitates a separate hand pump, or a pressure supply for starting."

The errors are so many that the entire paragraph needs to be re-written. Why does he hyphenate 'flash-proof' and not 'lamp oils' and 'air pump' or 'hand pump'? He uses 'which' with irritating frequency; he employs the abstraction 'complexity of apparatus' instead of the concrete 'complex apparatus', besides a plain error of grammar, namely, "requires . . . for the fuel to be contained". The writer is an educated engineer, but he disregards the obligations of an educated man.

Here follows an attempt to describe the operation of a machine-drill in a mine:

(3) "Following the shooting, the *mucker* begins his work, the drill man climbs to the top of the *muck*, and by the time the four feet of ground shot down is *mucked out*, he is again ready to shoot his round of holes."

"Muck", "muck", "muck"—it is the very muck of writing. The word means filth or manure. It is used as a synonym for 'dirt', the miner's term for broken rock. Thus 'muck' refers to the shattered rock resulting from blasting, which is not in the least filthy. Shovelers, that is, those who shovel the broken rock into the car at the face of a level or cross-cut, are now called 'muckers'. What gain is there? 'Shoveler' is significant, 'mucker'

*A chapter from the book on 'Technical Writing', just published.

[†]These quotations are from a lecture delivered at Cambridge by Sir Arthur Quiller-Couch. 'The Art of Writing'. 1916.

is the rubbish of words.

The next example comes from a description of the small locomotives used in mines. It reads:

(4) "Face gathering, wherein the locomotive must enter the room, imposes conditions which call for distinctly special treatment in the design and equipment of a locomotive of high efficiency. The ordinary haulage locomotive in nearly all cases is totally unfitted to this work, which involves operation in narrow quarters, around sharp curves, over poorly laid tracks, etc. The locomotive of real value in room work is one which, by reason of proportions and construction, will go wherever a mine car will run, and with equal facility. It must be compact, no wider than the wheels, with short wheel-base and small wheels, and without long overhang at either end."

This is the sort of thing that makes a technical description seem like a cryptogram or a slab of picture-writing from Nineveh. To anyone versed in the subject of locomotives for underground use, this paragraph is intelligible, but only that. It succeeds in making the subject as uninteresting as possible and places the meaning as much beneath the surface as the locomotive itself.

The last two examples come from 'write-ups', the trade name for a eulogistic description of a manufactured article, prepared in the interest of the manufacturer and written by a man more accustomed to the use of a screw-driver than a pen. The worst writing concerning technical matters is to be found in such disguised advertisements. They ought to be attractively written, to serve their purpose; in failing to do so, they illustrate the essential ineffectiveness of bad writing.

Grammatical correctness is no excuse for a statement that is likely to cause trouble to your reader. He must have your consideration always if you expect to be recognized as an effective writer. A technical journal states:

(5) "The specifying by a mining company that no man may be employed by it unless he be a member of such an organization, though undoubtedly legal, is as contrary to social justice as the specifying that no member of any organization will be employed, or the refusing to recognize any employee as representing anyone or anything except himself as an individual."

That reminds one of a passage in 'Alice in Wonderland': "Never imagine yourself not to be otherwise than what it might appear to others that what you were or might have been was not otherwise than what you had been would have appeared to them to be otherwise."

Here is more technical writing of a supposedly serious sort:

(6) "The expenditure involved is only justifiable with the assured certainty of very large ore reserves having values materially above operation costs." I suggest:

"The expenditure involved would be justifiable only by the certainty of an adequate reserve of profitable ore."

A respectable engineer writes:

(7) "They would go to the lay-out and see if it was checked out; if found out to be laid out, the lay-out foreman would spend his time in looking for it, and if he

could not find it he would get out a new one."

Such stuff is a disgrace to the profession; moreover, it is proof of such want of intellectual power as to argue against the possession of technical understanding.

Shun outworn figures of speech, like 'a bolt from the blue', 'the swing of the pendulum', 'the cry is still they come', 'after us the deluge', 'the Mecca of their pilgrimage', 'the Phoenix from his ashes', 'open Sesame', and 'the labors of Hercules'. They rarely give point to technical description; usually they are mere tags, in the reporter's style—a style to be scrupulously avoided in technical writing. Abstain from the use of such verbal inanities as 'festive', 'pristine', 'erstwhile', 'materialize', and 'eventuate'. These are precious to the reporter, but taboo to the intelligent writer.

Take note of the fact that nonsense remains nonsense however much you may disguise it in a veil of words. We think in words, and when we lack clear words we lack clear thoughts. Clear thinking is necessary to effective speech or writing. The forceful utterances and keen analyses to be remarked occasionally in men devoid of academic training show that the question of clear statement depends upon logic. Correct speech—grammatical speech—is logical speech. The following is a quotation from an address delivered by a prominent financier in San Francisco:

(8) "Let us learn, then, to realize that each has his dominion and his empire of domination, in which by the exercise of these qualities that are alike in spelling success each may rise to a position of leadership, with potentialities of power as great in its sphere of action as that one of the many, to whom we look for the time being, because of some particular preferment as a leader."

This is balderdash. It is "the delirious trimmings" of language.

Early Victorian elegance has no place in technical writing; for example:

(9) "The ore was relieved of its moisture through the medium of drying kilns." Meaning that:

"The ore was dried in kilns."

Nor do we want late Nevadan uncouthness:

(10) "With the installation of the new air-compressor underground development is being prosecuted more rapidly."

Is the air-compressor underground or is it being used for development underground? Should a comma come before or after the word 'underground'? The rapid progress is not being made "with the installation" of anything, but by the new compressor, operating more machine-drills. You do not prosecute a development; for that involves the pursuit of an abstraction.

(11) "The tributer is assisted in the prosecution of his work by being given supplies."

'Prosecution', in this context also, is a foolish word, apart from being an abstract noun. Slovenly writers who use such words also use too many others. He meant to say:

"The tributer is assisted in his work by being given supplies"; meaning candles, dynamite, caps, and fuse.

(12) "Gold Mountain was turned down by a *succession* of eminent engineers." It would be more to the point to give the names of some of the engineers.

(13) "He extracted the gold in the residue, thus *doing away with* [obviating] the *necessity* for [need of] re-handling it."

It was not the 'necessity', but the 're-handling', that he wished to avoid. Was it the gold or the residue that he was trying not to 're-handle'? He meant to say: "He extracted the gold in the residue, thus avoiding re-treatment."

Slovenliness in writing is due not to poverty of ideas but to careless thinking. It may escape censure because the majority of readers are uncritical and too patient. Given a careless writer and an equally careless reader, you have a performance about as profitable as a lecture to the deaf.

(14) "The Lake Superior copper mines are making a good recovery from the disorganized condition in which the long persistence of the strike put them."

Here you have the abstract phrases "the long persistence" and "making a good recovery" instead of a concrete statement saying that the strike had lasted long and that work at the mines had been resumed. 'Mines' is not the real subject of this statement, but the work being done in them. He—and he was an editor—meant to say:

"The working force at the Lake Superior copper mines is being re-organized and operations are being resumed after the long strike."

Statements that seem intelligible and are accepted by the patient reader without protest may yet fail to convey information accurately; and the docile reader—for every man that submits willingly to the attraction of an article, and reads it, is in a docile mood—either loses interest presently because of the vagueness of the discourse or struggles against the obstacles of clouded style until he is inclined to attribute the difficulty to a temporary mental inability of his own. The headaches of young students in their struggle to conquer knowledge from text-books are due more to the defective literary technique of the writers of the text-books than to difficulty inherent in the subject or to stupidity on the part of the learners.

(15) "The vein is a quartz fissure with a width of 1 to 6 ft., a dip of 50° to the north, and a filling of galena, sphalerite, pyrite, and chalcopyrite."

How can it be a fissure filled with quartz—for that is a quartz fissure, not a fissure in quartz—if it is filled with the four other minerals specified. Nor is the fissure attached to a width or a dip. He meant:

"The vein is from 1 to 6 ft. wide, it dips 50° north, and consists of quartz containing galena, sphalerite, pyrite, and chalcopyrite."

'Encounter' is a word greatly overworked. It means to meet hostilely or in conflict. The use of it in varying senses tends to vagueness.

(16) "The rocks indicate to the miner when *encountered* the general lower limits of the volcanics."

He means that where (not 'when') a particular rock is

found underground, there the lower limit (not 'limits') of the volcanic series is indicated. Therefore he might have said:

"These rocks, wherever found in the mine, indicate that the lower limit of the volcanic series has been reached."

(17) "The ore-bearing volcanics are seemingly of more importance to the district from a gold-producing standpoint than was at first supposed."

He meant that the volcanic rocks had a greater influence upon the deposition of gold in the district than had been supposed. He used 'seemingly' three times in eight lines of his manuscript, and you can infer from that how careless he was.

(18) "Some difficulties are *encountered* by the formation of sodium sulphate in the roasting furnace, which dissolves together with the sodium chromate."

Here 'encountered' means 'caused'. The wrong use of 'which' makes the writer state that the furnace 'dissolved'. The omission of the hyphen suggests that the furnace was 'roasting'. 'Together' is redundant. What he meant to say was:

"During the process of roasting, sundry difficulties are introduced by the formation of sodium sulphate, because it dissolves with the sodium chromate."

All these pluralities, generalities, and abstractions are the mark of jargon. As Quiller-Couch says: "To write jargon is to be perpetually shuffling around in the fog and cotton-wool of abstract terms: to be forever hearkening, like Ibsen's Peer Gynt, to the voice of the Borg exhorting you to circumvent the difficulty, to beat the air because it is easier than to flesh your sword in the thing."

Avoid extravagance. One of the chief obstacles to precision in writing is prolixity, the employment of superfluous words. Shy at such phrases as 'with regard to', 'in respect of', 'at the same time', 'as a consequence of', 'in connection with', 'from the standpoint of', 'on the basis of', 'of such a character', 'to any extent', 'according as to whether', 'on the whole', 'more or less', and so forth. Occasionally one or another of these unlovely locutions may be useful or necessary, but resort to them grudgingly, treating them as first cousins to jargon, which is the newspaper prostitution of our language.

(19) "With regard to the process, the principal difficulty that arose *in connection with* the operation of it was the large amount of dust; the success of it therefore depended as to whether it could, or could not be collected without incurring a *more or less* prohibitive expense."

The 21 words italicized are mere 'empties' in the train of thought. Note too the careless use of 'it'; the first and second refer to 'process', but the third refers to 'dust'. He might have said:

"The success of the process depended upon the economical collection of the dust made during the operation."

(20) "For it is well known that man's methods are ever changing while Nature's laws upon which they depend are invariable."

Two unnecessary and insipid clauses are interjected

under the false impression that they give dignity to the statement. How much stronger it sounds thus:

"For while man's methods are ever changing, Nature's laws are immutable."

(21) "Mistakes in assaying are far commoner than is generally thought to be the case."

"Mistakes in assaying are more common than is generally supposed."

(22) "Perhaps a few notes as to some of my experience in connection with mining in Colombia will be of interest."

"Perhaps a few notes on my mining experience in Colombia will be interesting."

(23) "The special difficulty in the case of flotation arose in connection with the treatment of the concentrate."

This might be changed to

"The special difficulty in using flotation presented itself when treating the concentrate."

Or, preferably,

"The main obstacle to the use of flotation was difficulty in treating the concentrate."

(24) "Any lumps of *more or less* [nearly] pure chalcocite were but superficially altered."

A mining journal says:

(25) "A *particularly* striking thing of the last Anaconda report is the exhibit of that company as the great metallurgical concern *that it is*."

The superfluous words are indicated. The statement can be amended thus:

"The latest Anaconda report exhibits that company as a great metallurgical concern", or

"This report exhibits the Anaconda as a great metallurgical enterprise."

Another author wrote thus:

(26) "So far as the writer is aware, the process has not been applied to any ore in this country, but there can be no doubt that there are many instances where it could be successfully applied."

This is a windy performance. What he wanted to say was:

"So far as I know, the process has not been tried in this country, but there must be many ores to which it could be applied successfully."

(27) "Probably flotation is due to a combination of phenomena *which* [that] are *rather high in the scale of* complexity."

"Probably flotation is due to a combination of complex phenomena."

(28) "From the standpoint of [according to] this theory."

(29) "This is too important a matter to be treated from a careless point of view [carelessly]."

(30) "From a genetic point of view the genesis of the coralline limestone have [has] been most carefully studied." Delete the words italicized.

The last three examples are borrowed from 'Suggestions to Authors' by George M. Wood, the editor of the U. S. Geological Survey.

Such words as 'case', 'instance', 'nature', 'degree', 'character', and 'condition' should be used sparingly and with discrimination.

(31) "So in the case of these veins we have present a reversal of the usual case where native copper turns to sulphide in depth."

This statement is typical of a kind of jargon that masquerades as ornate speech. He meant to say:

"Thus these veins reverse the experience usual in mining, namely, the change from native copper to sulphide mineral in depth."

(32) "In the case of copper it is not advisable to leach the ore."

"It is inadvisable to leach the copper ore."

(33) "The surface is of a very uneven character."

Delete the words italicized.

(34) "The soft nature [softness] of the rocks."

(35) "The lowlands in some cases [places] contain lakes, the most conspicuous instances being Crystal, Glen, and Portage lakes."

Here 'instances' is an elegant variant of 'cases'. It should be deleted.

(36) "This is the only instance in the district of a copper mine that is wholly in the granite."

"This is the only copper mine in the district that is wholly in the granite."

(37) "In every case an alteration product should be identified with extreme care." Delete the words italicized.

As Mr. Wood suggests, the victim of this habit of using 'cases' and 'instances', or some other similar abstract term, should ask himself what he means by the word. What is the concrete thing about which he is writing? He is likely to discover that he is indulging in mere verbiage.

(38) "The miners returned to work in most instances."

They went to work in overalls. He meant: "Most of the miners returned to work."

(39) "Even in Carboniferous areas, only in one or two instances do the veins carry ore."

Substitute 'places' for 'instances'. Perhaps he means "only one or two veins carry ore".

(40) "The accident was due to the dangerous nature of the work and the fissile character of the rock."

It was not; the accident was due to the weakening of the rock by fissuring and the sudden fall of a large piece upon the miner working below.

(41) "A singular degree of mineralization marks the district."

Meaning that "intense mineralization characterizes the district."

(42) "The auriferous mineralization is distributed throughout the ore and consists of metallic gold and gold associated with iron pyrites."

This is thoroughly bad, from beginning to end. 'Mineralization' is the condition of being mineralized; how can a condition be 'auriferous', that is, gold-bearing. Next, how can 'mineralization' be distributed through-

out the ore; it is an abstract idea; he means gold, thus:

"The gold in the ore occurs free and associated with iron pyrite."

The word 'situation' is beloved by jargoners; it is a type of the abstract, of the general, and of the woolly.

(43) "To meet this *situation* [difficulty] as it developed, *sand-filling* [the filling of stopes with sand] was introduced in 1908." The same writer continues:

(44) "Previous to this date some of the older mines had been showing signs of movement, and it became evident that preparation was necessary to *meet this tendency*, which was bound to increase in intensity as mining progressed."

'Tendency' goes well with 'situation'; both are abstract terms, the mere fog of an idea. He meant to say:

"Previous to that year some of the older workings had shown signs of movement, so that it became evident that a systematic effort must be made to check the settling of the ground, a condition sure to become worse as mining progressed."

(45) "He first went to Goldfield to examine a *mining situation* [mine] and then *located* [remained or resided] there for good."

To examine a situation is like fighting a chimera.

"He first went to Goldfield to report on a mine, and decided to live there."

(46) "This serious *situation with respect to dye-stuffs* has been splendidly met by the chemists of the country."

"This serious need of dye-stuffs has been met splendidly by the chemists of the country," or

"This serious deficiency in dye-stuffs has been overcome with splendid success by the chemists of the country."

(47) "The *situation in regard to fuel* is so alarming as to call for the most careful consideration."

He means: "The shortage of fuel at this time is so alarming as to demand serious thought."

The same writer continues:

(48) "Our *greatest* [best] opportunity for *success in meeting the fuel situation* [escape from the dilemma] lies in efficient combustion."

A mining lawyer writes:

(49) "An apex could not exist in *situations* [under conditions] *not greatly dissimilar* [similar] to those in the Jim Butler case."

(50) "The *labor situation* is passing through a period of unrest."

'Situation' is a mere abstraction; it is 'labor' that is unrestful.

(51) "He took an option on an *interesting situation* [promising prospect] on Canyon creek."

(52) "He liked the *situation* [the mine or property] and decided to invest his money in it."

(53) "The *easing up* of the oil *situation* was in sight. "The passing of the crisis in the oil industry was assured."

As might be expected, the jargoner loves such an abstract term as 'values'.

(54): "In my tests made with a view of [to] studying

the form in which *lay the values* [the gold and silver exist] in such tailings I have been unable to detect any *values* [precious metals] in the tailing from our ore."

How would he make tests to determine "the form" of the gold and silver until he had ascertained the fact that they existed in the tailing? When a writer makes such statements, he is not to be trusted.

'Problem' is another word dear to the jargoner in search of abstractions with which to obscure his want of accurate knowledge.

(55) "One of our serious *problems* is clean water."

He means: "One of our chief hindrances [or handicaps] is the lack of clean water."

(56) "*The problem presented by* this difficulty engages the attention of metallurgists." Delete the words italicized.

(57) "The *water problem* is a drawback to concentration."

"The large amount of water required is an obstacle to concentration."

'Standpoint' is a jargonistic decoration.

(58) "The portion of the range that is of interest *from an economic standpoint* extends due east and west about six miles."

"The portion of the range that is of economic interest extends due east and west for six miles."

'Eliminate' is another first cousin to jargon.

(59) "The presence of barite or gangue will in most cases *eliminate the possibility of using gravity concentration*."

He was writing about oil-shale.

"The presence of barite or other heavy minerals will usually prevent the use of gravity concentration."

(60) "One company has succeeded in treating this shale in a small retort, and is *contemplating the installation of* [planning to erect] a larger plant."

To 'contemplate the installation' is pure jargon.

(61) "The method has been employed *in connection with* the Herreshoff furnace *installation*."

"The method has been applied to Herreshoff furnaces."

(62) "The *problem of water-losses* was taken up coincidentally with the stack-loss determinations." He is referring to the metallurgy of quicksilver.

"The loss in water was investigated at the same time as the loss in fume."

It is likely that many of the examples quoted by me will seem to you by no means bad; in fact, they represent the kind of writing that is so common as hardly to call for comment by those whose critical faculties have not been awakened; yet, I assure you, the avoidance of just such jargon is essential to good writing. Jargon defeats its purpose; the thought fails to reach its destination; the cross-currents distract the tired reader's attention, they interrupt the voyage of his thought, which drifts with the flux of words and becomes stranded at length on a shoal of verbiage. Brevity is the soul of wit; conciseness is the essence of clarity; every unnecessary word tends to obscure.

The Future of Chromite in the United States

By SAMUEL H. DOLBEAR

After many years of production on an insignificant scale, the mining of chromite in the United States became an important industry in 1916. During the following two years production grew to 82,350 tons, in 1918.

Its principal applications to American industry are in the manufacture of ferro-alloys, chromium chemicals, and fire-brick. The industries manufacturing products from the raw ore and those consuming the manufactured products are large, representing investments of many million dollars.

Heretofore the raw material for the manufacture of chromium products has come chiefly from foreign countries, imported here from long distances by water. The cost of ocean freights, rather than an increase in the amount needed, brought about a demand for the American ore, at prices that made the exploitation of American deposits profitable.

The sudden cessation in demand in 1918 is too well known to require discussion. It was due, as is generally known, to the failure of the embargo on importation, while the Armistice served only to lock the gate that had already been closed. That the mandate of the war industries and shipping boards was totally disregarded can be shown no plainer than by a statement of importations of chromite during 1916 and 1917, when no embargo existed, and 1918 when it was supposed to have been effective:

Year	Long tons
1916	115,945
1917	72,063
1918	100,142

The importations under embargo exceeded by 33½% those of 1917 without embargo. Available supplies in the United States in 1918 were, therefore, 182,492 long tons of ore in addition to whatever stocks remained on hand from the previous year's business.

The normal pre-war consumption of chrome ore in the United States was about 48,000 tons per year for about 7 years preceding 1915. The rate of consumption grew steadily and rapidly in this period, increasing from 27,876 tons in 1908 to 65,180 tons in 1913 and 74,686 tons in 1914. During the war period the increase in demand was offset in part at least by difficulties in importation, uncertain domestic production, and restrictions on consumption and sale of chromite, more particularly its manufactured products.

There will continue an average yearly increase in consumption due to normal growth of business in this country. Economies in the use of chromite were, however, developed during the War. This is particularly true in refractories. Much less chrome brick is used than heretofore. The steel-mills will continue to practise these

economies until the price drops to a point where the economy disappears.

Compared with the intense activity of 1918, the past year presents a sorry contrast. Stocks in the hands of miners on January 1, 1919, were estimated at 42,687 tons.* Only a few hundred tons were shipped from these stocks during the year. Instead of 600 active operations, there were four or five; these mined and shipped only 1400 tons during the first six months. Most of this material was shipped to ferro-chrome plants in Colorado and California. Imports during the first ten months of 1919 were 55,380 tons or about 67,000 tons for the year.

The American chromite industry has declined to near oblivion. Efforts are being made by some of the producers to secure a tariff sufficient to protect domestic operations against cheap foreign ore. The chief competitive countries are New Caledonia and Rhodesia, in which countries the deposits are larger and purer than those in the United States. The Caledonian ore is produced by French convict labor.

The bill introduced in the House by Representative Julius Kahn, calls for a tariff of 60 cents per unit of 1% chromic oxide, equivalent to \$30 per ton on 50% ore. Prices quoted in January for 50% ore f.o.b. New York were 70c. per unit, or \$35 per ton. The immediate effect of the tariff would therefore be to raise the price of 50% ore f.o.b. New York to about \$1.30 per unit or about \$65 per ton.

During the four years that chrome ore was intensively mined, the deposits closest to the railroads were first operated. As they were exhausted and the price increased, new deposits were opened, each time reaching farther from transportation lines, until, in 1918, mines were worked 50 or 60 miles from rail. The ore was carried by pack animals, wagons, and trucks; and in many cases hauling costs constituted the principal item in the expense of production. No notable mines, comparable with those of New Caledonia or Rhodesia, were found. By the middle of 1918, it was well known that if production was to be maintained, it would have to be accomplished by concentration. Several operators had already built mills, and efforts at large-scale production were devoted to mines that had developed sufficient reserves of low-grade material. This was the condition at the close of the War and is the condition today. In no other way could American mines provide the quantity and quality of product necessary.

Chromite is an essential element of warfare. No military campaign could be successful without it. We now

*U. S. Geological Survey.

know clearly what we must expect if foreign supplies should actually be shut out. Domestic mines would have to produce larger quantities—somewhere between 75,000 and 200,000 tons per year during the period of isolation. Warfare with any of the leading sea-powerful nations might easily exclude importations from New Caledonia, Rhodesia, and other distant sources. With greater difficulty supplies from such points as Cuba, Brazil, and Alaska could be cut off.

It is important, therefore, that we should examine closely into the available supplies in America to determine if these are sufficient to justify exploitation and use in peace-time industry. If our chromite resources are bountiful and sufficient to last for a long period ahead, then there is no problem of national security involved. On the other hand, if the proved resources are deficient, depletion becomes at once a military problem. Stocks of chromite normally in the hands of users would be sufficient to last for six months if war-time economies are properly put into effect. It is necessary then that domestic mines be kept in readiness to assume responsibility of large production on six months notice. Experience in the recent war has taught us that a ponderous and long-debating Congress would require this length of time to visualize the situation and act upon it. It is essential for the safety of the nation that the domestic operations should retain their status as producers, or at least as potential producers ready to resume production on short notice. Deposits easily available were largely exhausted during the past five years. There remain, as the chief sources of ore, the mines situated at a distance from rail, necessitating hauling over mountain roads. If these roads are neglected, they will readily become impassable and eventually become obliterated. Concentration plants already erected must be maintained. If the owners are unable to operate them for profit, they will either crumble or pass into the hands of the junk-man.

My attitude is that of a protectionist. I believe in the development of American industries, and I do not want to see American labor reduced to the level of the peasantry of Europe for the benefit of competition. Moderation is essential in the practice of any doctrine, and any rule carried far enough finds the need for exceptions. The doctrine of protection and its complexities is too long a subject for discussion here.

The immediate effect of the tariff would be, as before stated, to raise the price of ore to about \$1.30 per unit f.o.b New York. The value of the ore at point of shipment in the West would depend largely on the point to which the material is destined. The value in California would be determined by deducting from the New York price the freight between the mine and New York. Ore of 50% grade would be worth about \$48 per ton on cars on main-line points in California and Oregon at the present time. As ocean-freights and the cost of foreign production decrease, the price of American ore would have to drop an equal amount. At Chicago the price of ore would be the New York price plus the freight from the point of entry to Chicago. The tariff would, of course,

reduce the amount of ore consumed in this country.

Foreign manufacturers of leather, colors, and products into which chromium enters as an incidental item, being free from the burden of tariff on chromium, would be favored by the differential in cost of production, and these foreign goods, unless excluded, would enjoy a complete advantage over similar American-made goods. While this might also be overcome by tariffs, the American manufacturer would have to meet this disadvantage in attempting to market his wares in foreign countries. All of this is, of course, true of every product for which protection is sought.

SUMMARY. If supplies in America are sufficient to enable operation without hazard to the national security, the problem is one of protection against foreign mines.

If supplies are deficient and operation of American mines would imperil the safety of this country in time of war, the problem is military.

We cannot risk our national security on a guess that our resources are ample, nor on the assumption that operation will develop large deposits hitherto unknown. The field has been pretty thoroughly prospected and the latter is unlikely.

The U. S. Geological Survey is in possession of much information regarding these resources, and as most of the larger producers are claimants under the War Minerals Relief Act their properties have been, or will be, visited by engineers of the Bureau of Mines. A careful review and correlation of these data should make it possible to determine accurately in which class of problem the chromite industry belongs.

If we are self-sufficient, chromite should be encouraged in every possible way. If conservation is necessary for military reasons, our military departments should undertake the preservation of American deposits as potential producers. It is entirely precedent that the mines and equipment be purchased by military appropriation, the equipment and workings kept in order, and maintained. Such an act would parallel the Naval Petroleum Reserve, and the reservation for governmental purchase of petroleum and helium under the Oil Lands Leasing Bill.

Our experience in the War justifies a similar military survey of all of the so-termed war minerals, and the record should be revised at frequent intervals to correspond to current developments.

DURING 1918 Hongkong exported tin to the United States to the value of \$10,299,203. At that time the United States had to have tin at practically any price. During 1919, when conditions became more nearly normal, the United States was able to choose its tin where it could buy cheapest, and the result was that Hongkong-Yunnan tin could not compete in price with tin from the Straits Settlements, where it is produced on a gold basis. The tin exported from Hongkong to the United States during 1919 was valued at only \$496,115, and most of that was shipped in the last two months of the year on consignment for whatever price it would bring, to get it out of the way of the new year's stock of tin.

Arizona's Oldest Copper Mine

By F. Le R. THURMOND

The oldest copper mine in the State of Arizona is the Planet, situated on the Bill Williams fork of the Colorado river, about 15 miles from Swansea. It has been leased to the Consolidated Smelting Co., and a force of men is at work preparatory to commencing actual mining. The history of the mine dates from 1865, when rich oxidized ore was mined and hauled 12 miles to the

the price of copper was high, lessees mined and shipped about half a million dollars worth of copper, hauling the ore with trucks to Midway, a station on the Arizona & Swansea railroad. It is said that no ore was shipped that assayed less than 6% copper.

The ore mined to date has been oxidized, largely carbonate and silicate, with the latter predominating. Hematite or specularite is the principal gangue mineral. The orebodies occur in veins or lenses, in the pre-Cambrian complex, made up for the most part of granite gneiss, with many patches and areas of complex meta-



THE COMET SMELTER IN 1884



DETAILS OF BLAST-FURNACE AT THE COMET SMELTER

Colorado river. Here it was loaded onto flat-boats and floated to the Gulf of California, thence in sailing vessels around 'The Horn' to Swansea, Wales. About a million dollars worth of copper was thus produced before trouble with the Indians, added to the depletion of the richer orebodies, caused operations to be suspended.

In 1884 a smelting furnace with a capacity of 30 tons per day was erected and operated for five months. This plant is shown in the accompanying illustrations. One thousand tons of slag that it produced was shipped by lessees in 1917, the smelter returns from which showed an average copper content of 5%. When examining the remains of this slag-dump I found pieces of slag containing numerous shots of copper varying from one to four millimetres in diameter. From 1915 to 1917, when

morphosed sediments, the whole being intruded with mesozoic lavas, which seem to have given rise to the iron oxide segregations with which the copper is associated. Hematite-limestone contacts form the loci of the workable orebodies.

SHIPMENTS OF COPPER from the United States to Japan during 1919 were unusually heavy. Ordinarily Japan is not a large consumer of American copper. Attention has frequently been called to the possibility of Japan entering extensively into the manufacturing of copper and brass material. Approximately 70,000,000 lb. of copper was exported to Japan last year against only about 450,000 lb. in the previous ten years. The effort to capture the Asiatic trade in copper goods formerly held by Germany may be one incentive for these heavy purchases.

The McFadden Bill

To provide for the protection of the monetary gold reserve by the maintenance of the normal gold production of the United States to satisfy the requirements of the arts and trades, by imposing an excise upon all gold used for other than monetary purposes, and the payment of a premium to the producers of newly mined gold, and providing penalties for the violation thereof.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That on and after May 1, 1920, in addition to any existing tax now assessed or levied thereon, there shall be levied, assessed, collected, and paid a tax of 50 cents per pennyweight of fine gold contained in all gold manufactured, used, or sold for other than coinage or monetary purposes, by or for a manufacturer or dealer, or his estate, on or after such date, and upon the gold contained in any manufactured articles sold by any dealer or manufacturer, or his estate.

SEC. 2. That the Internal Revenue Department shall prescribe and provide a proper and sufficient stamp that shall be attached to or imprinted upon any and every manufactured article, or the package containing the same, in which gold is used, that may be sold after the 1st day of May, 1920, and upon all gold used in any form other than for monetary purposes after the said May 1, 1920. The stamps to be so provided and authorized to be sold and imprinted upon or attached to such manufactured articles, or the packages containing the same, shall be in such form, and shall be imprinted upon or attached to, the articles or packages, at such time and in such manner as may be provided by the rules and regulations of the Internal Revenue Department carrying this Act into effect.

That on account of the impracticability of suitably stamping finished dental restorative appliances, the Internal Revenue Department shall further prescribe such rules and regulations for the collection of the tax provided herein upon all gold used for dental purposes as will equitably protect the interests of the public; that all gold used by the Government for dental, medical, and surgical purposes, and all gold employed in dental services rendered to war-risk insurance patients by the United States Public Health Service, shall be exempt from the excise provided herein; and that all gold used in corrective and restorative dental work for children of both sexes not over the age of fifteen, and all gold used in dental infirmaries conducted for the benefit of the poor and not for private profit, shall be exempt from the excise provided herein.

SEC. 3. That all moneys collected pursuant to the provisions set forth in section 1 of this Act shall be paid into the custody of the Treasurer of the United States, and shall be kept by him in a separate fund designated as "the gold premium fund", and shall be used and paid out in accordance with the provisions of this Act as here-

in set forth, and for no other purpose; except that if, at the end of any current year, a balance has accrued in the gold premium fund over and above the amount necessary to pay the premium obligations that have accrued thereunder, it shall be the duty of the Treasurer to place said balance in the general fund of the Treasury of the United States.

SEC. 4. That from the gold premium fund, and any other funds in the Treasury of the United States not used for specified purposes, there shall be paid by the Treasurer of the United States, after the 1st day of May, 1920, and for a period of five years thereafter, to the producer of new gold in the United States or its possessions a premium of \$10 per fine ounce, in accordance with the provisions of this Act hereinafter set forth.

SEC. 5. That for the period commencing May 1, 1925, both the tax and premium as herein set forth shall be readjusted annually by the Secretary of the Treasury, the Secretary of Commerce, and the Secretary of the Interior, meeting as an adjustment board for such purpose; that said readjustment shall be made in accordance with the commodity price index number of the fifth year of the five-year period hereinbefore designated as compared with the average commodity price index number for the first four years of said period; that the index numbers of all commodities governing this readjustment shall be those ascertained and published by the Bureau of Labor Statistics of the Department of Labor; that the said tax and premium as readjusted shall constitute the amount of tax and premium that shall be collected and paid during the year next ensuing; and that each readjustment shall be made annually prior to the 1st day of May of each succeeding year, which shall determine the amount of tax and premium to be collected and paid.

SEC. 6. That on and after May 1, 1920, every producer of gold from any mines in the United States or its possessions, who shall be entitled to the provisions of this Act shall deliver the gold so produced to the United States Mint, or its authorized agencies, accompanied by a sworn statement setting forth the place where the gold was mined, the dates between which it was mined and prepared for market, and that no gold obtained from any other source is contained therein. In the event any gold was recovered from ore by custom smelting or milling, the proprietor, or his managing agent, or an executive or managing officer of any such smelting or milling company shall make and deliver to the producer a sworn statement stating the date or dates on which such ore was delivered for smelting or milling and the date that the gold recovered from said ore was delivered to the producer and the amount of gold so delivered to him.

Upon the delivery of any such gold, accompanied by the sworn statement of the producer, or accompanied by the sworn statement of the smelting or milling agency, the Director of the Mint shall execute and deliver to such

producer a certificate setting forth the number of fine ounces of newly mined or smelted gold then and there delivered by such producer, and shall set forth the amount of premium to which the producer is entitled.

In the event that ore containing gold is delivered for smelting or milling by the producer of the ore to a custom smelter or mill, and in the usual smelting or milling practice the same cannot be treated without delay, the smelting or milling company may follow the usual smelting or milling practice, purchase said ore, and receive the certificate, under oath, of the producer, setting forth the time and place of the mining thereof, and pay to the producer thereof the monetary price of \$20.67 and the premium as herein provided upon each fine ounce of gold so recovered by said smelting or milling company, which, upon such payment, shall be entitled to all the rights of the producer of the ore as of the date of delivery of the ore to such smelting or milling company, and upon the presentation of the certificate of the producer, together with a certificate of such smelting or milling company setting forth all of the facts as required by the rules and regulations established hereunder, shall receive the same amount of money as a premium for such gold so produced and delivered to the smelter or mill as the producer may have received if such ore had been smelted or milled and the gold returned to the producer of the ore.

That every person or corporation so producing newly mined gold from any mines within the United States or its possessions on and after May 1, 1920, and who shall deliver the same to the United States Mint or its authorized agencies as herein provided shall be paid therefor the sum, amount, or consideration as now provided by existing law, and in addition thereto, shall be entitled to receive on the certificate issued by the Director of the Mint, as herein provided, the additional sum of \$10 for every ounce of fine gold so mined and delivered to the United States Mint or its authorized agencies: *Provided*, That no gold bullion in any form whatever shall be issued or delivered to such gold producer in payment of, or in exchange for, any such newly mined gold so delivered as herein provided: *Provided further*, That the Director of the Mint may coin any such gold so produced and delivered and deliver to any such producer the coin minted therefrom, or the Director may deliver to any such producer coin in exchange for such newly mined gold, as is now authorized under existing laws.

SEC. 7. That upon the delivery of the gold and the sworn statements as hereinbefore set forth to the United States Mint, or its authorized agencies, a certificate shall be issued by authority of the Director of the Mint to the producer or his order certifying that the holder thereof is entitled to receive from the Treasurer of the United States the sum specified therein as payment of the premium for the production of new gold from the funds in the custody of the Treasurer herein provided.

SEC. 8. That any person who purposely or knowingly shall violate the rules and regulations of the Internal Revenue Department referring to the collection of this excise imposed upon gold for other than coinage or

monetary purposes, or who shall sell or dispose of any article containing gold to which there has not been affixed, or upon which there has not been imprinted, the proper stamp, without first affixing or causing to be imprinted thereon such stamp as shall be provided by the Internal Revenue Department of the United States, shall be guilty of a crime against the United States and shall, upon conviction, be imprisoned not more than five years or fined not more than \$10,000, or both.

SEC. 9. That any person, whether acting for himself or as agent or officer of any gold producer, smelter, refiner or milling company, who purposely or knowingly, by any art, way, or means, shall himself adulterate, or procure or solicit another to adulterate, any gold presented to the United States Mint for which a certificate for the payment of a premium as provided herein is requested, or who shall purposely or knowingly make a false statement, or procure or solicit another to make a false statement, in any statement or certificate required herein, which would entitle the producer to receive a premium on the production of gold herein provided for, shall be guilty of a crime against the United States and shall, upon conviction, be imprisoned not more than five years, or fined not more than \$10,000, or both.

SEC. 10. That all administrative, special, or stamp provisions of law, including the law relating to the assessment of taxes, so far as applicable, are hereby extended to and made a part of this Act, and every person liable to any tax imposed by this Act, or for the collection thereof, shall keep such records and render, under oath, such statements and returns, and shall comply with such regulations as the United States Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may from time to time prescribe.

Whenever in the judgment of the United States Commissioner of Internal Revenue necessary, he may require any person, by notice served upon him, to make a return or such statements as he deems sufficient to show whether or not such person is liable to tax. The Commissioner, for the purpose of ascertaining the correctness of any return or for the purpose of making a return where none has been made, is hereby authorized by any revenue agent or inspector designated by him for that purpose, to examine any books, papers, records or memoranda bearing upon the matters required to be included in the return, and may require the attendance of the person rendering the return or of any officer or employee of such person, or the attendance of any other person having knowledge in the premises, and may take his testimony with reference to the matter required by law to be included in such return, with power to administer oaths to such person or persons.

SEC. 11. That any person required under this Act to pay, or to collect, account for and pay over any tax, or required by law or regulations made under authority thereof to make a return or supply any information for the purposes of the computation, assessment or collection of any such tax, who fails to pay, collect or truly account for and pay over any such tax, make any such return or

supply any such information at the time or times required by law or regulations, shall, in addition to other penalties provided by law, be subject to a penalty of not more than \$1,000.

Any person who wilfully refuses to pay, collect, or truly account for and pay over any such tax, make such return or supply such information at the time or times required by law or regulations, or who wilfully attempts in any manner to evade such tax shall be guilty of a misdemeanor, and, in addition to other penalties provided by law, shall be fined not more than 10,000 or imprisoned for not more than one year, or both, together with the costs of prosecution.

Any person who wilfully refuses to pay, collect, or truly account for and pay over any such tax, shall, in addition to other penalties provided by law, be liable to a penalty of the amount of the tax evaded, or not paid, collected, or accounted for and paid over, to be assessed and collected in the same manner as taxes are assessed and collected: *Provided, however,* That no penalty shall be assessed under this subdivision for any offense for which a penalty may be assessed under authority of section 3176 of the Revised Statutes, as amended, or of sections 8 or 9 of this Act, or for any offense for which a penalty has been recovered under section 3256 of the Revised Statutes.

The term "person" as used in this section includes any officer or employee of a corporation or a member of or employee of a partnership, who, as such officer, employee, or member is under a duty to perform the act in respect of which the violation occurs.

Secondary Metals

Part of the metal or metals contained in drosses and skimmings undoubtedly is recovered and re-used several times in one year. Similar conditions prevail in the use of all junk or waste material. New clean scrap is sold and becomes mixed with old scraps contained in articles that have been used and discarded. New clean clippings of zinc, tin, and aluminum are usually carefully segregated from other scrap metals, but many dealers in metals, or smelters, do not keep separate records of other new clean scrap and old used metals. The quantity of the various metals contained in numerous alloys made partly or wholly from secondary material cannot be definitely ascertained. The figures given by the U. S. Geological Survey are only approximate, but they are the only available data of an important industry.

The value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferro-alloys, recovered in the United States decreased from \$295,854,900 in 1917 to \$264,298,900 in 1918. The decrease was due to much lower average prices of copper, zinc, lead, and antimony. The value of the secondary platinum, iridium, and palladium recovered in 1918 amounted to \$5,077,000, which was nearly as much as the value of the platinum and allied metals imported for consumption in the United States in 1918.

The value of the old jewelry, dental waste, silver spoons, tableware, ornaments, and other articles containing gold or silver remelted or refined in 1918 was more than \$25,500,000. Mints and refineries reported the recovery of 8,526,122 oz. of silver and \$16,931,600 of gold from waste or discarded material. Jewelry and dental waste are the largest sources of secondary gold, and silverware and photographic wastes of secondary silver. The increased value of silver naturally resulted in the return of large quantities of old spoons and other tableware to the melters, and the large increased sales of photographic material resulted in an increased quantity of silver used in that industry. Some idea of the recovery of silver from moving-picture laboratories is furnished by the fact that one small refining plant reported the recovery of more than 30,000 oz. of silver from photographic waste. It is difficult to estimate the value of ferrous scrap remelted in 1918. Estimates of the quantity vary from 12,000,000 to 14,000,000 long tons. Owing to the enormous consumption of iron and steel for war purposes there was a large increase in the quantity of scrap ferrous alloys available. A considerable part of the scrap ferrous metal contained nickel, tungsten, manganese, chromium, vanadium, molybdenum, or other alloys, which made it many times more valuable than the ordinary commercial iron and steel scrap, though the market is limited and some knowledge is necessary to find prospective purchasers. All of this high-priced ferrous metal scrap will be absorbed into trade channels, although it will take considerable time to use the large accumulations of nickel steel and other special ferrous alloys. There continued to be a considerable quantity of scrap metals from abandoned steam and trolley railways, but the quantity of old metals marketed by operating railway companies was less than usual. Buying of new material by railways was restricted to urgent needs, consequently smaller quantities of old rails, car wheels, and other equipment were discarded. The railways are on the whole the largest producers of most kinds of metal scrap, as well as the largest users of new and remelted metal. It is estimated that the railways discard more than 8,000,000 tons of iron and steel yearly. One large railway company estimated that its purchases and manufacture of bearing metals in 1917 amounted to more than 21,000,000 pounds.

The dealers and brokers in ferrous metals think that the prices paid by users of iron and steel scrap since November 1918, have not been fair in that they have showed a much greater percentage of decrease than the prices of iron and steel products made from this old material.

It is impracticable and unnecessary to segregate the statistics relating to the melting, refining, and using of secondary metals according to States, but more than 90% of the refining and smelting of drosses and scrap metals in the United States is confined to the territory east of St. Louis and north of Ohio river. Nearly all the secondary aluminum was reported from the States of Ohio, Michigan, Connecticut, Illinois, Indiana, and Wisconsin.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

SILVER MINES NEAR PRESCOTT ARE BEING REVIVED.

PRESCOTT.—A large consolidation of mining properties has been affected by the newly organized Peak Silver Mining Co. The officers are H. H. Keays, president; Charles A. Weidler, secretary and treasurer; and J. E. Pierson, general manager. The consolidation takes in the old Emporia, Black Horse, Benedict, Yellow Jacket, Lluvia de Ora, Happy Home, Bornite, and Lost Burro properties which are in various stages of development. Unwatering of the Black Horse shaft, 130 ft. deep, is in progress. The last work done thirty years ago resulted in shipping three carloads of high-grade silver ore. A gasoline hoist is being put in. The best developed property in the group is the Emporia, which has been a producer for a number of years until just prior to the War. Two shafts each 200 ft. deep and considerable lateral work constitute the development. It is estimated that 9500 tons of ore is available for immediate mining. The new company plans to use the oil-flotation process and a stamp-mill. The company also has available nearly 4,000,000 ft. of virgin pine timber, and a 2000-hp. water-power. Ore in former years has been mined profitably from six of the properties of the consolidation. The value of the visible assets of the company is estimated at slightly over half a million dollars. There are 15 known parallel veins of ore in a width of three miles, which carry gold, silver, and copper. It is expected that high-grade silver ore will be found in the Black Horse as soon as the old workings are cleaned out. The Emporia mill is to be equipped with flotation early this spring. The area that is being taken over includes 62 mining claims or about 1220 acres on the Hassayampa river 10 miles south of Prescott.

Mine-owners of the Prescott district have been watching with interest the operations at the Monte Cristo silver mine, on Groom creek, 8 miles south of here. W. H. Worthington and Grover Hubbel, of Wickenburg, have acquired this old mine by purchase. The shaft is 400 ft. deep, with much work done on levels above the 300-ft. point. The main orebody is from 2 to 3 ft. wide, with a rich streak of shipping ore 15 in. wide in the centre. Recently, the owners started a 10-ft. K & K flotation machine in the old mill, which is now making a 95% recovery. A smaller sized K & K machine is to be used as a cleaner and will increase the capacity to 40 tons per 24 hours and is expected to raise the recovery.

The success of this flotation plant in the silver district

south of Prescott, which begins 4 miles from town and extends 30 miles beyond Crown King, a distance of at least 65 miles south from Prescott, means the re-awakening of the mining spirit of the entire district. There was no process to successfully handle the sulphide silver ores prior to the development of the flotation process. Plans are already being made by five new companies, which have taken over old and partly developed properties of this district, to use the flotation process in old mills which have not turned a wheel for ten to forty years.

Announcement is made of the purchase of the Gladiator and War Eagle gold mines, at Crown King, by the Philadelphia Mining Co., which owns the adjoining property on the west. A tunnel on the older property, 1200 ft. long, is to be used in the development of the newly acquired properties, which will give a depth of 1200 ft. under the apex. Flotation will be used in the old mill. George Harrington, of Crown King, is the principal in the deal in Arizona.

MAYER.—The Half Moon Copper Co. has found rich copper glance ore in a drift 170 ft. north from the bottom of the 500-ft. shaft. The streak is 12 in. wide and assays 49% copper. The face of the drift is in milling ore. In the west cross-cut, three feet of chalcopryrite ore averaging 4% copper, has been cut. The property is half a mile south of the Arizona Binghamton mine, in the Copper Mountain district, five miles north-east of Mayer.

MIAMI.—It is reported that the Old Dominion Copper Co., by sinking to the 1900 and 2000-ft. levels, has increased its ore-reserves by 500,000 tons. Copper oxide occurs in the 1900-ft. level owing to the displacement of the Pinal Creek fault; this is believed to be of great importance as it proves a westerly extension of the ore-bodies. The depth to which the ore can be profitably worked will depend on the amount of water to be handled, 7,000,000 gallons now being pumped. Under the present reduced operations the mine is producing 850 tons of ore per day.

The Iron Cap Copper Co. shipped 7300 tons of ore during March. Work on the new mill is reported as progressing rapidly. It should be completed by the middle of May. The treatment in the new mill comprises rod-mills for both primary and secondary grinding; roughing tables, following initial grinding; secondary grinding; flotation; drag classifiers; and tabling of the sands. The ore to be treated is mostly bornite and it is expected that an extraction of 95% will be obtained. The Iron

Cap ore is at present being treated in the Inspiration mill.

It is reported that development at the Arizona Commercial has opened ore between the 600 and 1600-ft. levels up to a width of 40 ft. running 5% copper. The plans for the new 1500-ton mill of the Old Dominion, which is to handle the milling ore of the Arizona Commercial, have been completed.

Preparations are under way to renew churn-drilling at the Porphyry Consolidated. C. E. Bosworth, mining geologist of Phoenix, is making a surface examination of the property. Any new ore developed pending negotiations for the sale of the Porphyry Consolidated property to the Inspiration Consolidated Copper Co. will be taken care of by increasing the purchase price, it is announced.

MONTANA

STRIKE OF THE MINERS AT BUTTE.

HELENA.—The Muskegon mine, operated by the Lump Gulch Mines Co., has a large body of ore blocked out on the 230-ft. level. Extensive cross-cutting throughout the mine it is expected soon will put the property on the list of producers.

POTOMAC.—The Potomac Copper Co. is now employing 30 men. No. 4 tunnel is 1300 ft. long and with 400 ft. additional driving it is expected to reach a point directly under the surface outcropping on the mountainside 500 ft. above the tunnel portal. This outcrop is 300 ft. long and 100 ft. wide and averages 3% copper and 10 oz. silver. The tunnel-face is now in quartzite containing seams of copper. The mine is situated eight miles from a railroad. It is reached by a road that was constructed last summer at a cost of \$10,000. W. I. Higgins is superintendent.

COOKE CITY.—The Glengarry Mining Co., owner of the Scotch Bonnet group of properties, expects to commence shipping ore as soon as weather conditions will permit. The ore from the mine is transported to Gardner by truck, 53 miles, and then by rail to the smelter. Tunnels show a block of high-grade ore 42 ft. deep, 36 ft. wide, and 74 ft. long. From 40 to 50 tons of ore is expected to be shipped daily. Other properties that will operate this year are the Republic, the Yellowstone Mining Co., and the Western Power & Smelting Co. The Republic has worked all winter and has more than 5000 tons of ore on the dump ready for shipment. This ore promises to assay close to \$100 per ton in gold, silver, and copper. W. D. Marlow is president.

BUTTE.—The Tuolumne company, operating the Main Range group, mined and shipped 45,000 tons of ore during March, which was a 40% increase over the February production. Smelter returns show assays of 3% copper and 12 oz. silver. The Spread Delight vein has been penetrated and bears out all expectations. Already timber to the width of four sets has been placed without reaching the hanging wall. The cross-cut in the direction of the Rory O'Moore vein has encountered a fault which has delayed reaching the expected orebody.

The Homestake Mining Co. has let a contract for 900

ft. of tunnel on its property on Big Trout creek in the Thompson Falls district. The vein varies in width up to 42 ft. The copper ore is found in a kidney-type formation.

The mines of Butte were closed down on April 20 by a strike called by the local I. W. W. Heavy picket duty by the 'wobblies' made the tie-up complete. Enough of the engineers, pumpmen, and metal-tradesmen succeeded in getting to work to prevent the mines from being flooded or otherwise damaged. No ore is being hoisted. It is estimated that close to 12,500 men are idle as a result of the strike. Armed deputies clashed with pickets on the Anaconda road and 16 of the latter were wounded, some seriously. Governor Stewart has been appealed to for protection and troops are expected to arrive. Many miners are leaving the camp and an acute shortage of labor is expected when operations are resumed. The strike was engineered and is almost entirely dominated by a foreign-born element. The demands are listed as follows: (1) Release of industrial and political prisoners; (2) six-hour day collar to collar; (3) minimum daily wage of \$7; (4) abolition of the rustling card; (5) abolition of the contract and bonus systems; and (6) two men on each machine and on all other work.

LIBBY DISTRICT.—The Lukens-Hazel property has added to its reserve by discovering a 9-ft. vein of gold-quartz ore. The mill is nearing completion. A satisfactory adjustment of the litigation tying up the Snowstorm mine has been made. The buildings are being repaired and early operation is looked for. Cady, Sheffield, and Criderman report satisfactory development progress on their Automobile group of claims.

NEIHART.—The Neihart Silver Mines Co. has hopes of developing a large orebody through the 100-ft. level of the Broadwater tunnel. This ore is 200 ft. from the Blackbird claim. Samples assay from 30 to 200 oz. silver per ton. It is planned to connect both the Blackbird and Silver Belt properties with the Broadwater tunnel for economical operation and more advantageous exploration. Transportation from the Broadwater is by aerial tram.

The Moulton mine of the Cascade Silver Mines Co. has made such rapid development as to necessitate the purchase of a new air-compressor. The finds reported in the lower levels are holding out as work progresses.

NEVADA

TONOPAH MINERS STRIKE AGAIN.

TONOPAH.—Labor trouble has broken out again, following persistent rumors of radical activities which have continued since the settlement of the strike last fall. The trouble has spread to the Divide district after practically closing the Tonopah mines. The radicals in control of the situation have presented a list of demands that is in some respects humorous. They ask the immediate release of all industrial and political prisoners, a 6-hour day from collar to collar, with a minimum wage of \$7; two men on all machines, clean sheets twice every week in the bunk-houses, "with springs and mattresses and plenty of blankets"; one man to a room, his bed to be "made

up each day and his room to be cleaned of all dust and other things which may accumulate". After reading the demands a mine operator said: "I knew it was coming to this. If we give them their demands now within three months we shall have a strike based on a demand for valets, one for each miner."

YERINGTON.—The Rockland Mining Co., the principal interest in which is held at Canton, Ohio, has been declared bankrupt, with an indebtedness of \$55,000, and the trustee has been ordered to sell the mine and equipment on the claims 25 miles south of Mason valley. Dissension among the stockholders, resulting in their refusal to complete payments on \$125,000 worth of machinery, is given as the reason for the company being bankrupt. The vein, of an average width of 2½ ft., has been opened to a depth of 1300 ft. The principal content of the ore is gold, with silver associated with antimony and arsenic in sufficient quantity to make the ore refractory. The reduction plant is an all-slitting cyanide mill of 75 tons capacity. The mine is reported to have produced \$350,000 gross, but lack of development work in recent months leaves little in sight.

ELY.—A 100-ton cyanide mill has been completed and will soon start operating at the old Argus mine at Taylor, 16 miles south of here. The mine is opened to a depth of 300 ft. and it is said to have produced 2,000,000 oz. of silver ore in the early days. It is estimated that ore in surface dumps is ample to keep the mill supplied for more than a year. The mine dump is estimated to contain 265,000 oz. of silver, and 18,000 tons of tailing gives an average assay return of over 6 oz. silver and 80 cents in gold. The estimated silver content per ton of the mine dump is 14 oz. The mine and mill are owned by the Wyoming Mining & Milling Co., of which E. P. Bowman, of Cody, is manager. The claims are across Steptoe valley from the Ward lead-silver mine.

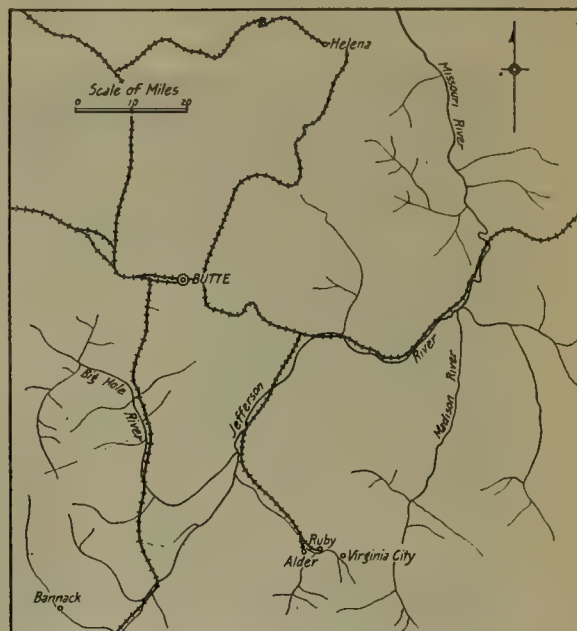
WONDER.—It is reported that George A. Manning, of New York, has financed a company to take over and operate the Vulture, Bald Eagle, Spider Wasp, Goldconda, and Dickey V. groups. The affairs of companies formed by Henry Weber to develop these groups over 10 years ago led to two noted cases in the criminal court in Goldfield, in which Weber, promoter of the Atlanta Mines Co. in Goldfield, was the defendant. The rise in the price of silver led to the formation of the new company, as the ores of the district contain four parts silver to one of gold.

BELMONT.—The Consolidated Spanish Belt company, 7 miles south-west of here, has started the erection of a 10-stamp mill to treat silver ore assaying from \$10 to \$30 opened since work was started by the company in December 1916. The Spanish Belt owns the old Barcelona and San Pedro mines, which produced rich ore many years ago. The San Pedro shaft was reopened by the present management and the Ernst tunnel workings, from which a production of \$500,000 is said to have been made in the early days before the miners were driven out by water, were drained by a 1300-ft. tunnel. Since then thousands of feet of work has been done and for several

months regular shipments of high-grade ore have been made.

DIVIDE.—A 9-ft. width of ore estimated to have an average value of more than \$100 per ton has been opened at a depth of 310 ft. in the Victory and shipments have been started. The 9-ft. width includes 1 ft. of the richest ore ever found in the district and 5 ft. of \$139 ore. The ore was found in a drift from a 110-ft. winze from the 200-ft. level and the winze will be sunk an additional 50 ft. and another cross-cut will be driven to the vein at this depth.

QUARTZ MOUNTAIN.—The Bell group of claims on Quartz mountain, 12 miles east of Goldfield, has been



MAP OF TERRITORY SURROUNDING BUTTE

optioned by M. J. Conroy, of Los Angeles, for a price reported to have been \$80,000. The group consists of eight claims on the eastern edge of the Goldfield hills. The vein is 110 ft. wide and the following assays were secured from the surface by Corrin Barnes, a Goldfield engineer who made the report on which the option was taken. An 8-ft. width, \$8; 18 ft., \$17; 24 ft., \$5.20. The gold is entirely in flakes embedded in the quartz and in some cases embedded in the quartz phenocrysts of the original rock. The best assays were secured over a width of 60 ft. The vein, which has a general northerly strike and dips 70° E., has been traced on the surface for 1500 ft. It is estimated that a tunnel now 160 ft. long will cut the vein at a depth of 140 ft. if continued an additional 65 feet.

COPPER CANYON.—George B. Thatcher, former Attorney General of Nevada, and associates have been notified that the United States Supreme Court has denied a motion for a re-hearing in their case against Joseph Ralph, which involves ownership of the Copper canyon gold placer deposits in Humboldt county. Thatcher and his

partners now expect to secure clear title to the claims, which cover what is said to be one of the richest placer deposits in the country. The average width of the main channel is 150 ft. and the claims cover it for 2300 ft. There is little water available for washing the gravel.

NEW MEXICO

WORK RESUMED AT OLD CARLISLE PROPERTY.

GRANT COUNTY.—The Duncan Mining & Milling Co., Steeplerock mining district, H. E. Spence, manager, has completed a 125-ton milling and cyaniding plant costing \$125,000 to operate on its own ore as well as to handle customs ore from the surrounding mines in the Steeple-rock district. The mine is developed by a 300-ft. shaft and has sufficient \$12 to \$20 gold-silver ore blocked out to operate the mill for several months. The old Carlisle mine, which has produced \$6,000,000 in gold and is one of the famous high-grade mines of the South-West, has lately staged a come-back with the discovery between the 300 and 400-ft. levels of what is believed to be the continuation of a high-grade ore-shoot which is said to have netted the original owners about \$3,000,000 when the mines were active 40 years ago. Shipments of gold ore running as high as \$60 per ton are being made to the American Smelting & Refining Co. at El Paso by G. F. Utter and Livingstone Utter, lessees.

The Lone Mountain district, 10 miles south-west of Santa Rita and 4 miles west of Hurley, is showing signs of activity after having been idle for 35 years. Julian Padilla, leasing on claims of Roberts and Betts, is shipping several cars per week of lead-silver ore to the American Smelting & Refining Co.'s plant at El Paso. Placer operations are being resumed on Bear creek in the Pinos Altos district under the management of W. E. Caldwell, who, with associates, has secured control of large areas along the creek. Placer mining has been done in and near Pinos Altos since the discovery of the camp, but this is the first time an attempt has been made to work the deposits in a large and systematic way.

PYRAMID COUNTY. The El Centro Mining & Milling Co. in the Pyramid district has purchased equipment to sink the Last Chance shaft to the 500-ft. level to further develop orebodies which have recently shown well under development on the 275-ft. level.

UTAH

OPHIR CANYON IS BEING PROSPECTED.

GARFIELD.—Fifteen machine-shop workers at the Arthur plant of the Utah Copper Co. quit work on April 17, after submitting a statement that they did not "want to work on unfair castings that are in the shop". It seems that the men involved in the walk-out objected to machining castings that were made in foundries in Salt Lake City which are now on the 'open shop' basis, following a strike some months ago. R. C. Gemmell, general manager, gave out a vigorous statement, to the effect that from its very inception the Utah Copper Co. has maintained a free shop for free men, and has never discriminated between employees because they are or are not

members of any lawful religious, political, or labor organization; that the company has always adhered to an open-shop policy, which has been accepted by the employees of the company, and will continue to do so to the full extent of its ability and resources. Mr. Gemmell further stated that it was his belief that the men who quit did so with great reluctance, and that the walk-out was forced upon them and engineered by outside union organizers of Salt Lake City; that unscrupulous and reckless men, under the guise of labor leadership, are fomenting discord and industrial strife in their efforts to obtain power and control over the men they appoint themselves to represent; to such as these, the 'closed shop' would be a potent weapon, and in their control a menace to every principle of American government and individual liberty.

OPHIR.—Work under way in this camp indicates a big revival of mining, and it is expected that the coming summer will be the most active since the days when millions of dollars worth of ore was mined and smelted here. As a result of the work done during the past eleven months, the geology of the district has been revealed to such an extent that a large area of virgin ground seems available. The orebodies in this district occur as replacements of certain limestones, which are traversed by north-east and north fissures. Most of the output heretofore has come from the mines on Ophir hill, which is on the north side of the canyon. On the south side is what is known as Lion hill. On the property of the Ophir Central, on Lion hill, W. S. Elliott has been driving several diamond-drill holes. It is reported that these holes have been the means of correlating the structure on the two sides of the fault, and it has been determined that the Lion hill side dropped down approximately 600 ft. The Ophir Central company has a hoist, compressor, and other necessary machinery, and in a short time will begin sinking a shaft near the town to open up under Lion hill the lime strata which have been so productive on the opposite side. The largest of the mines on Ophir hill is the Ophir Hill Consolidated, which is owned by W. A. Clark of Montana and to date has paid \$12,000,000 in dividends. Work is being actively carried on at the Ophir Metals property, the tunnel being in a distance of 548 ft. from the portal, and it is expected that the objective limestone will be cut at a distance of 800 ft. The tunnel is now progressing at an average rate of seven feet per day.

PARK CITY.—Entrance of the United States Smelting, Refining & Mining Co. into the district is considered one of the most important events in the history of Park City. This company has taken a bond and lease upon the property of the American Flag Mining Co., which adjoins the Silver King Coalition on the east and the Ontario on the south. At present the United States company is carrying on diamond-drilling work on the 1100-ft. level and following up stringers of ore. In 1903 the American Flag company was organized to develop 22 claims, embracing approximately 300 acres, and since that time has produced in the neighborhood of \$500,000 in high-grade silver-gold ore. The ore contained little or no lead, was of a uni-

formly high grade, with a highly siliceous gangue. Based on current prices for silver, the lowest grade ore ever shipped from the property would be worth \$40 per ton; a number of shipments having been made that averaged from 68 to 252 oz. silver per ton, and from \$8.80 to \$29 per ton in gold. Since the Ontario drain tunnel lies 210 ft. below the lowest level attained in the American Flag mine, officials of the company believe that difficulties with water will be negligible. The formation is quartzite with two veins, one called the 'Main' and the other the 'Easter', which intersect, both on their dip and their strike. Most of the development work has been done in the Main vein, where a shaft was sunk to a depth of 1060 ft., with a sump 60 ft. below this depth. Approximately a mile of laterals has been run on the different levels.

BRITISH COLUMBIA

'DAYLIGHT SAVING' AT TRAIL.

ALICE ARM.—A tunnel has been driven on the Muska-teer claims by A. McGuire for J. D. Meenach of Seattle. It is reported that this work disclosed some high-class ore. Satisfactory results are said to have been obtained by the diamond-drilling that has been in progress on the Tiger group for some time.

PRINCE RUPERT.—Attention has been drawn by the Prince Rupert Board of Trade to the limonite deposit of the Copper River district situated near Copper City. Reference is made to the coal-fields of that locality, it being claimed that these contain the finest coking coal of the Province. The business men of Prince Rupert fear



SETTLER, SLAG-POT, AND LEAD BLAST-FURNACE AT THE EL PASO SMELTER

On the eleventh level, 60 ft. below the 1000-ft. level, a stratum of limestone about 30 ft. thick was cut. In this stratum, the enrichment, which had been considered excellent in the quartzite, became even stronger, and it was in this bed that some of the best grade of ore was mined.

Notices have been posted by the Silver King Coalition, Ontario, and Daly mines to the effect that beginning April 15; the companies would allow two extra shifts to all employees who work twenty-eight continuous shifts in a month. For some weeks past the Judge Mining & Smelting Co. has had a somewhat similar bonus system in operation. Like all other mining districts in the State, there is a shortage of miners in this camp, and several hundred more miners could be used here. The local mining companies are doing everything possible for the comfort of their employees as a means of keeping them steadily employed.

that the Provincial government and individuals or corporations, in their investigation of the iron and steel possibilities of British Columbia, will overlook these resources, together with the availability of water power and necessary fluxes.

PRINCETON.—The Horn Silver Mining Co., situated in the Similkameen district, is operating again after a period of idleness, weekly shipments of from 45 to 50 tons being sent to the Tacoma smelter. The lessees are working on a vein varying in width from 18 in. to 6 ft., the ore of which contains gold and silver. An aerial tramway carries the ore from the mine to the bunkers whence it is transported by wagon to the railway.

ROSSLAND.—The surface equipment of the White Bear mine was destroyed by fire recently. Flames first were seen bursting from the compressor-house. This soon was destroyed after which the mine-shaft and some unoccu-

pied houses were reduced to ruins. The transformer-house was saved by packing snow about it.

SLOCAN CITY.—That a stringer of ore has been opened up on the fifth level of the Ottawa mine, near Slocan City, which assays from 800 to 3000 oz. silver per ton, is reported. The vein was observed during the cleaning out of a drift and it was thought that it contained only about one sack of ore. Development appears to have disproved this and 10 cars already have been taken out, and the vein is now exposed for 20 ft. with a width up to 18 inches.

TRAIL.—The town of Trail, smelter centre of the Consolidated Mining & Smelting Co., proposes introducing 'daylight saving' this summer without regard to what action may be decided upon elsewhere. The company's clocks were set ahead an hour at midnight on April 15. Employees in and around the smelter expressed a preference for this arrangement and the management acquiesced. Ore receipts at the smelter for the week, April 1 to 7, were 4588 tons, making the total for the year to date 77,834 tons. The independent shippers were the Donohue, Nicola, 35 tons; the Emerald, Salmo, 41; the Josie, Rossland, 172; the North Star, Kimberley, 86; the Ptarmigan, Athlamer, 25; and the Spokane Trinket, Ainsworth, 46. The Sullivan mine, Kimberland, contributed 3978 tons of zinc and 205 tons of lead ore.

VANCOUVER.—There is still hope that the Dominion government will establish the long promised ore-testing plant in British Columbia. Some years ago \$300,000 was placed in the estimates to meet the necessary outlay but so far no steps have been taken toward building. Assurance, however, has been received that the money will be re-voted this year and that action may be looked for.

The 'Assayers' Examination Board' has completed a special examination of seven candidates who recently completed a five-month course of study at the British Columbia University under the auspices of the Soldiers' Civil Re-establishment Board. Four were successful and will receive certificates entitling them to practice their profession in British Columbia. They are E. D. Beilby, V. R. Thirkel, T. J. Laing, and F. W. Broughton.

ONTARIO

LABOR CONDITIONS TO IMPROVE IN PORCUPINE.

PORCUPINE.—Since the recent increase in the rate of wages labor conditions have been more satisfactory and harmonious. There is less restlessness among the miners, and a greater disposition to remain steadily at work in place of moving from camp to camp. With the coming of spring the logging season has closed and many engaged in lumber camps during the winter are looking for employment at the mines, which will probably tend to increase production. Diamond-drilling of the Dome Extension has been started by the Dome Mines to determine the extensions of known veins and ascertain whether the orebody developed on Dome Extension on the 600-ft. level continues at depth.

COBALT.—At the annual meeting of the Beaver Con-

solidated on April 15 a dividend of 3% was announced, being the first in two years. Frank L. Culver, president, stated that the company had taken over the Prince property adjoining and that underground development had been begun from the 1400-ft. level of the Beaver. The ore-reserves were estimated at 25,000 tons. The Kerr Lake during March produced 99,400 oz. of silver valued at approximately \$118,286. The company will at once begin treatment of the ore on the dump, amounting to about 80,000 tons, which has been accumulating for some years. The Northern Customs Concentrator Co. is now unwatering the No. 2 shaft of the Chambers-Ferland situated on the section of that property purchased a few months ago. No. 16 vein of the Chambers-Ferland is producing a good quantity of milling ore and some high-grade material. Arrangements are being made to extend the scope of operations on the Genessee. A winze will be put down from the 500-ft. level as it is estimated that the conglomerate formation extends at least 110 ft. downward. The vein on which the winze is to be sunk has a width in some places of from 12 to 15 in. and silver occurs in patches upon the walls and in small stringers which are offshoots of the main vein. The McKinley-Darragh is preparing to resume the pumping of old sand from the bed of Cobalt lake. A considerable quantity of tailing remains to be treated, which is expected to keep the mill in operation all this season and part of next year.

Up to the latter part of April, the silver-producing companies of Northern Ontario continue to withhold their bullion from the market, apparently with the belief that the recession in quotations for commercial bar-silver is but temporary. Milling equipment for the Keeley mine in South Lorrain was transported to the mine before the winter roads broke up, and the management is now free to proceed with the erection without delay.

GOWGANDA.—The speedy construction of a light narrow-gauge railway from Elk Lake appears assured, as a charter for that purpose has been granted to the Northern Light Railways Co. This will relieve the difficulty under which this district has labored owing to lack of transportation facilities. Leading operators have for some time been endeavoring to induce the Provincial government to construct a standard-gauge railway, but, having failed in this will support the other project.

LARDER LAKE.—At the annual meeting of the Associated Goldfields on April 16, G. A. MacKay, president, reported liquid assets in hand amounting to \$1,048,662 and total liabilities of \$11,164. During the year \$169,258 had been spent on development. Diamond-drilling had shown high-grade orebodies at least 500 ft. below the surface, of an average value of \$11.15 per ton. The company is building its first milling unit of 1000 tons daily capacity. A pool exists among the shareholders who were all bound not to dispose of their stock before July 1. The meeting decided to extend the pooling arrangement to 30 days after the mill is in operation and not later than January 1, 1921. H. C. Cooke, formerly with the Canadian Geological Survey, has been engaged as the company's geologist.



THE MINING SUMMARY

COPPER PRODUCTION

The following table shows the output of 18 of the leading copper producers during recent months and also compares the production for the first quarter with that for the same period in 1919. The figures are in pounds.

	March 1920	February 1920	First quarter 1920	First quarter 1919
Anaconda	18,450,000	18,500,000	55,050,000	42,200,000
Phelps Dodge	7,931,000	7,585,000	23,478,000	20,397,733
Utah	8,894,596	9,211,806	26,799,991	29,201,000
Calumet & Hecla	9,880,377	8,660,052	28,131,100	22,022,368
Inspiration	6,500,000	7,200,000	20,900,000	19,800,000
Chino	4,413,329	3,176,489	10,671,755	11,563,676
Miami	5,001,535	4,089,520	13,552,302	14,286,838
Ray Con.	3,900,000	3,885,000	11,684,073	12,412,000
Nevada Con.	3,700,000	3,850,000	11,731,938	12,200,000
Calumet & Arizona	3,164,000	3,948,000	10,352,000	11,048,000
New Cornelia	3,516,000	3,518,000	10,388,000	9,824,000
Arizona Copper	3,000,000	3,000,000	12,000,000	10,192,000
Old Dominion	2,358,400	2,013,000	6,966,300	7,746,000
East Butte	1,909,720	1,480,360	4,808,080	4,625,740
Granby	2,095,500	2,180,000	6,250,939	6,434,375
Greene Cananea	3,700,000	3,400,000	10,100,000	9,200,000
Cerro de Pasco	3,658,000	4,718,000	14,992,000	15,256,000
North Butte	1,833,176	1,168,509	5,541,745	3,967,033
Total	95,905,693	92,253,736	283,398,223	271,376,763

ALASKA

Juneau.—Charles Hayden, president of the Alaska Gold Mines, is quoted as saying: "The company can continue operation only so long as advantage can be taken of extracting ore already broken in stopes or prepared for mining, on which development and breaking costs have been previously paid either wholly, or in large part, thereby recovering the amount invested in the development and preparation for mining of such ore-reserves." The gold recovery last year decreased from 88c. to 66c. per ton as compared with the previous year, and there seems to be a question whether there is profit to be obtained even under a more favorable condition of the market for labor and supplies.

ARIZONA

Jerome.—The town where is situated the U. V. X. smelter is hereafter to be called Clemenceau. It was decided that Verde was confusing, as there was an old postoffice in the same valley by the name of Fort Verde. James S. Douglas, president of the Extension company, is said to have selected the new name, having in mind his overseas experience in the Red Cross at the Paris depot.

Phoenix.—The Arizona Cave Creek Mines Co. has recently been formed by A. S. Lewis, of Phoenix. The company is backed by prominent Rochester and Buffalo capitalists. The company will take over promising prospects in the Cave Creek district and develop them.

Pima County.—Percy Williams, general manager for the El Tiro Leasing Co., reports that ore is now being stoped at four places on the 200-ft. level, averaging better than 8%. Stope No. 4, with over 200 ft. of virgin ground overhead, is furnishing nearly one-half car per day of 7% ore. Certain portions of this new stope for eight feet in width average more than 10% copper. During March, 29 cars of ore were shipped, totaling 1457 dry tons, averaging 8.04% copper, which was sold at an average price of 18.28c. per pound. Four cars of this ore were produced by sub-lessees working at various points on the surface where there is enrichment.

Tucson.—B. Hatcher, of the assaying firm of Andrus & Hatcher of Tucson, has taken charge of the Roadside mine, 50 miles south-west of Tucson, for the Huntington interests of Los Angeles. A new shaft will be sunk, as the old shaft is in bad condition.

Yavapai County.—W. E. Plank is drilling some placer ground near the old Rich Hill diggings. He has a full crew at work, and so far his returns have been encouraging.

CALIFORNIA

Amador County.—Arrangements have been made for re-opening of the Fremont Consolidated mine under new management. Repairs are being made to the surface plant and the pumps will soon commence unwatering the old workings.

—The Garibaldi is yielding high-grade ore and is to be developed on a greater scale.—Representatives of outside capital are investigating the Drytown Consolidated and Crown Point mines with a view to their rehabilitation, according to advices.

Plumas County.—The discovery of copper carbonate in the drift left of the main tunnel is reported from the Feather River group. This ore was cut about 610 ft. from the tunnel-portal. The company recently ordered additional equipment.—Operations are in progress at the Engels, Walker, Gruss, Beardsley, Trask & Coffey, and other copper properties in the Plumas field, which is now the foremost producer of copper in California. Despite the high cost of labor and material and the unfavorable market operations in the Plumas field are active.

IDAHO

Boundary County.—At the Idaho-Continental mine, near Porthill, milling operations will be resumed as soon as a force can be assembled, according to A. Klockmann, general manager. Water is flowing in sufficient volume for the generation of power. Approximately 30,000 tons of ore is broken in the mine and the ore in sight is sufficient for one and a half to two years of milling. All of the concentrated ore on hand was hauled during the winter.

Coeur d'Alene.—H. E. Owen, of Spokane, head of the Wardner Leasing Co., has obtained an option for two years on the property of the Slavonian Mining Co. and the Petronivich claims having an area of 100 acres at Wardner. Included in the Petronivich claims is the Butler, from which high-grade ore was shipped.—The Caledonia Mining Co. has declared its regular dividend of \$26,000. This is at the rate of one cent per share on the issue of 2,605,000 shares. The disbursement, which will be made May 5, will raise the total dividends to \$4,063,800.—The Nabob Consolidated Mining Co. has plans for the installation of equipment for saving the zinc in its ore. The value of the zinc passing through the mill is estimated at \$300 per day. An important saving is anticipated from a new electric-haulage system in the lower tunnel.

The present board of the Hecla Mining Co. was re-elected at the annual meeting at Spokane recently. James F. McCarthy is president, treasurer, and manager. The board of directors has authorized the disbursement of an extra dividend of \$50,000 at the time of the regular quarterly disbursement of \$150,000 in June, making the total payment

\$200,000 or 20c. per share on the issue of 1,000,000 shares. The forthcoming payment will increase the grand total of dividends to \$8,205,000. The company is hoisting 750 tons daily. About 600 tons of this is passed into the mill, the remainder being waste and shipping ore. The quantity of material hoisted is greater than at this period a year ago, but less than that of a corresponding period two years ago. Shipments are being made at the rate of 100 tons per day.

MISSOURI

Joplin.—The Bethlehem Zinc Co., which several years ago developed a lease one mile east of Quapaw, which was worked with some success, now is opening a lease near Treece, Kansas, that promises to be as successful as other mines of that district. The lease contains fifty-five acres on the Wright land and is next south of the Silver Fox mine. All the ground has been thoroughly drilled and a shaft has been sunk into ore, which is found at 250 ft. The drilling proved high-grade ore in a large part of the lease. The shaft is in ore that runs 25% zinc. The company will move its mill from the lease of the Quapaw to the new lease and will push the work as rapidly as possible. The mill is of 300 tons capacity and is in good condition. Herman B. Jones, of Joplin, is manager.

The Prospectors Development Co., whose property is just south of the Blue Bonnett mine at Hockerville, has seven drill-rigs at work testing its forty-acre lease. Eighteen holes have been drilled and it is said good ore has recently been found. The company has a 150-ton mill in operation, but for several months has run the plant only enough to make expenses of operating, as there has been a shortage of water for milling purposes and there have been a number of changes under way. It seems that the Blue Bonnett found more than enough water at 250 ft. and plants of the St. Louis company, adjoining the Prospectors lease, found too much water at less than 200 ft., but the Prospectors has never had as much water as it wanted, although it has sunk to 265 ft. J. D. Simpson is president.

NEVADA

Goodsprings.—The downward extension of the orebody which has produced so well for the Yellow Pine Mining Co. has been cut on the 1000-ft. level, 600 ft. north of the shaft, at a point near where the dip and rake of the shoot on the level above indicated it would be found.

At the Yellow Pine mill the U. S. Bureau of Mines men have been carrying on volatilization tests, with the idea of driving off silver and lead and precipitating the same from the fume by the Cottrell process. The tests were made in a calcining furnace 60 ft. long and 5 ft. diameter, which is used for driving off moisture and carbon dioxide and thus decreasing the weight of the ore in proportion to the amount of these elements present. This is believed to be the first time that the Bureau of Mines men have had the opportunity to work on this kind of experiment on a commercial scale. The results obtained are said to have been highly satisfactory, after some changes were made in pressure employed in the fuel burner.

Obituary

George Schroter Patterson was accidentally killed on April 14 at the zinc mine of the Northern Ore Co., at Edwards, New York. He was born at Denver, Colorado, on October 9, 1892, and graduated from the Denver High-School and from Columbia University School of Mines, in the class of 1914, receiving the degree of Engineer of Mines. For two years he was at the Franklin Furnace mines of the New Jersey Zinc Co., in the capacity of surveyor, shift-boss, etc. In 1916 he was appointed mine superintendent for the Northern Ore Co. and general manager for the same company just previous to his death.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Charles Butters is at Mazatlan.

Arthur W. Jenks has returned from New York.

James S. Douglas has returned from New York to Bisbee.

Walter Fitch, Jr., mining contractor of Eureka, Utah, is in Pennsylvania.

W. S. Van Dyck has moved from San Jose, California, to Unionville, Nevada.

A. W. Allen left New York for Chile on April 21, expecting to be away for six months.

J. H. Wolf has returned from Korea, where he was in the service of the Seoul Mining Co.

James O. Ray has returned to Palo Alto from the old silver district south of Austin, Nevada.

O. M. Kuchs, general manager for the International Smelting Co., of Salt Lake City, is in New York.

R. A. Brown has been appointed consulting engineer for the Michigan Utah Con. Mines Co. at Alta, Utah.

Karl Kithil has returned to Denver after investigating the new radium discovery in Grant county, New Mexico.

J. Power Hutchins arrived in New York on March 12 and sailed again for London on his way to Italy on April 24.

Jules Labarthe has resigned as a director of the Bunker Hill company, his place being taken by **Frank M. Smith**.

A. E. Robinson has left the Utah Con. Mining Co. to take charge of the Hidden Treasure mine at Lake City, Colorado.

H. C. Goodrich, chief engineer of the Utah Copper Co., has returned to Salt Lake City after a trip to Duluth and Chicago.

R. K. Neill has resigned as manager of the Premier mine, in the Salmon River district, B. C., and is succeeded by **Dale L. Pitt**, his assistant.

H. V. Winchell was in Salt Lake City recently. On April 26 he addressed the 'Hoover for President' Club at a luncheon given at the Newhouse hotel.

Albert Burch has been appointed manager for the Simon Silver-Lead Mines Co., at Mina, Nevada. Previously he was consulting engineer to this company.

John Hay, Jr., has been appointed consulting engineer to the Pioche Mines Co., having assumed the position made vacant by the death of **Oscar A. Knox**.

Norman W. Haire has resigned as general manager for the Michigan Utah Con. Mines Co. at Alta, Utah. **Nicholas A. Robertson** has been chosen to succeed him.

H. G. S. Anderson, assistant general manager for the Chino Copper Co. at Hurley, New Mexico, was married on April 8 to Miss Mary McCrae, at Rolla, Missouri.

John V. Richards, of Spokane, Washington, having resigned his commission as Major in the United States Army, is manager for the Wilshire Bishop Creek Mine, at Bishop, California.

D. W. Leeke, on his return from the west coast of Mexico, sailed, on April 23, for the Philippines, having accepted an appointment as engineer on the staff of the Benguet Consolidated Mining Co.

H. Trencar Thomas, metallurgical engineer to the Ooregum Gold Mining Co. of India, has been visiting our Western mining districts and left San Francisco on his return to London on April 28.

Victor C. Alderson, president of the Colorado School of Mines, will sail on May 19 from New York to England. While abroad he will visit the shale districts in Scotland and France, inspecting recent discoveries and methods of extraction.

THE METAL MARKET



METAL PRICES

San Francisco, April 27

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	12.11
Copper, electrolytic, cents per pound.....	10.25
Lead, pig, cents per pound.....	9.50-10.50
Platinum, pure, per ounce.....	\$125
Platinum, 10% iridium, per ounce.....	\$135
Quicksilver, per flask of 75 lb.....	\$97
Spelter, cents per pound.....	10.25
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

April 26.—Copper is inactive but steady. Lead is quiet and easier. Zinc is dull and lower.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending
Apr. 20.....	117.50	68.50	Mch. 15.....121.90
" 21.....	117.75	68.62	" 22.....123.42
" 22.....	116.75	68.62	" 29.....125.81
" 23.....	118.00	69.50	Apr. 5.....126.50
" 24.....	118.00	69.62	" 12.....123.75
" 25 Sunday.....			" 19.....118.12
" 26.....	118.00	69.62	" 26.....117.67

Monthly averages

Date	1918	1919	1920
Jan.	88.72	101.12	132.77
Feb.	85.79	101.12	131.27
Mch.	88.11	101.12	125.70
Apr.	95.35	101.12	
May	95.50	107.23	
June	99.50	110.50	

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Apr. 20.....	19.00
" 21.....	19.25
" 22.....	19.25
" 23.....	19.25
" 24.....	19.25
" 25 Sunday.....	
" 26.....	19.25

Monthly averages

Date	1918	1919	1920
Jan.	23.50	20.43	19.25
Feb.	23.50	17.34	19.05
Mch.	23.50	15.05	18.49
Apr.	23.50	15.23	
May	23.50	15.91	
June	23.50	17.53	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Apr. 20.....	8.85
" 21.....	8.80
" 22.....	8.75
" 23.....	8.75
" 24.....	8.75
" 25 Sunday.....	
" 26.....	8.75

Monthly averages

Date	1918	1919	1920
Jan.	8.85	5.80	8.85
Feb.	7.07	5.13	8.88
Mch.	7.26	5.24	9.22
Apr.	6.99	5.05	
May	6.88	5.04	
June	7.59	5.32	

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920
Jan.	85.13	71.50	62.74
Feb.	85.00	72.44	59.87
Mch.	85.00	72.50	61.92
Apr.	88.53	72.50	
May	100.01	72.50	
June	91.00	71.83	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
Apr. 20.....	8.50
" 21.....	8.35
" 22.....	8.30
" 23.....	8.30
" 24.....	8.30
" 25 Sunday.....	
" 26.....	8.45

Monthly averages

Date	1918	1919	1920
Jan.	7.78	7.44	9.56
Feb.	7.87	6.71	9.15
Mch.	7.87	6.53	8.93
Apr.	7.04	6.49	
May	7.92	6.43	
June	7.92	6.91	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Average week ending
Apr. 20.....	95.00
" 21.....	100.00
" 22.....	100.00

Monthly averages

Date	1918	1919	1920
Jan.	128.06	103.75	89.00
Feb.	118.00	90.00	81.00
Mch.	112.00	72.80	87.00
Apr.	115.00	73.12	
May	110.00	84.00	
June	112.00	94.40	

In its current publication on the financial situation, the National City Bank says:

The whole credit situation was helped sentimentally by the announcement that the British and French governments would pay the \$500,000,000 joint loan which will become due in October next. It was a moral tonic which had immediate effects. Proof that these countries were not bankrupt was hardly necessary, but sentiment in the exchange and investment markets had been despondent to a degree that required a cheerful surprise of this kind to dispel the prevailing pessimism. The announcement had that effect for several reasons, the most influential of which, perhaps, was the promise that a considerable amount of gold would be forthcoming which would serve to replenish our reserves and make good the losses which we have seemed destined to suffer by exportation to Argentina and Asia.

The gold situation was on everybody's nerves March 1, and we discussed it at some length in the March letter. The excess of gold exports over imports in January was \$35,740,487, and in February \$38,527,000, a total since January 1 of \$74,267,487, and the margin of excess reserves in the Federal Reserve system was so narrow as to arouse misgivings that more drastic action might be taken by the authorities for the reduction of loans. The announcement that the loan would be paid, together with a rumor that gold shipments would begin at an early day, instantly relaxed the tension. At about the same time, the demand for gold on account of India eased off in London to such an extent that two lots aggregating about \$3,000,000 were obtained for the United States, and another \$3,000,000 came in from Canada.

It still remains to be developed how much gold will come in payment for the Anglo-French loan. It is known that the British government has been accumulating credits here by the sale of American securities and Australian wool, and has been buying the Anglo-French notes in the open market. Probably its share of the loan will be largely cared for in that way. It is not so clear how the French government will take care of its half of the undertaking, but special efforts have been made to bring the last internal loan to the attention of investors in this country, and the subscriptions doubtless have aggregated a considerable amount. The first installment on the gold payments, approximately \$9,000,000, arrived on March 28. The fact that shipments have begun so early indicates that the total amount is expected to be a large sum.

The most that can be said for this promise of gold is that it relieves to some extent the anxiety as to diminishing reserves. It affords no reason for expecting a renewal of credit expansion. The Federal Reserve authorities have been moving cautiously in their policy of freeing the reserve banks from war-paper and getting those institutions back into normal condition, but there is no reason to doubt that they are firm in the purpose. Whatever gold is received will be all needed to provide against the exports which must be counted upon, and it would be very short-sighted to modify the loan policy which has been adopted. With the credit expansion of the last year as a warning, and the revelations which are being made of speculative investments by means of bank credit in sections of the country where liquidation might have been rapidly accomplished, it is plain that for the good of the country the situation should be held firmly in hand. The country should be urged to pay its debts and practice for a time the old-fashioned policy of earning and accumulating before spending or investing.

MONEY AND EXCHANGE

Foreign quotations on April 27 are as follows:

Sterling, dollars:	Cable	3.71
	Demand	3.70
Francs, cents:	Cable	5.93
	Demand	5.92
Lire, cents:	Demand	4.40
Marks, cents		1.80

Eastern Metal Market

New York, April 21.

Buying of all metals has been held up by the railroad strike and the markets are all very quiet. There has been some decline in prices.

Demand for copper is exceedingly light from domestic sources but prices are only slightly changed.

The tin market is very quiet and buying has been negligible. Prices continue fairly high.

Lead prices have declined in the outside market.

Buying of zinc continues insignificant and prices are lower.

There is little change in antimony.

IRON AND STEEL

While the end of the railroad strike is in sight the delivery of steel products is seriously disorganized and the return to normal conditions is not expected for a good many days, says 'The Iron Age'. Buying has been much curtailed in the past week and manufacturing consumers of pig-iron and of rolled steel have been compelled in many cases to shut down wholly or in part because their fuel supply was cut off.

Weakness in steel plates, long predicted because of the large producing capacity, is not much in evidence. Two more British shipyards have been buyers, both at 4c., Pittsburgh, one for 7500 tons and the other for 2000 tons, with 19,000 tons additional in the latter case yet to be placed.

COPPER

There is almost an entire absence of buying of electrolytic copper. Demand a week ago was noted as having fallen off and this tendency has been greatly intensified by the railroad strikes which have interfered with shipments from mines to smelters and from smelters to refineries, to say nothing of shipments to consumers. This is true of all the metals in a greater or less degree. The large producers are firm in their quotations for electrolytic copper of 19 to 19.25c., New York, for early delivery. For June a slight premium is the rule and for third quarter a decided disinclination to quote at all except where necessary, in which case about 19.50 to 19.75c. is asked. In view of the heavy buying a few weeks ago demand is necessarily light from domestic consumers. Buying for export to Germany, France, England, Switzerland, and other countries is exceedingly good and last week exports of copper were 1525 tons to France, with Germany second at 1185 tons. Lake copper is quoted at 19.25c., New York, for April-May delivery, at which level a good sized order was sold late last week. A premium is obtainable for forward shipments.

TIN

The market has been and is exceedingly quiet and no business has been done for some days. Prices have maintained a fairly high level, due to the continued high quotations in the London market. This fact, together with the railroad strikes, has influenced consumers to remain out of the market. They have at no time been buyers except when prices receded. They also recognize that it is no use to buy what cannot be shipped. Yesterday spot Straits was quoted at 62.25c., New York. The London market was strong at £349 10s. for spot Straits. This is about £3 higher than a week ago. Late last week there were a few sales of April-May and May-June shipment from the East at around 61c. When the general situation clears up a better demand is confidently expected. Arrivals thus far this month have been 1279 tons, with 3691 tons reported afloat.

LEAD

The strength that was noted a week ago has disappeared. While buying has abated because of railroad strikes, tend-

ing to weaken the market, this situation was aggravated by the sudden offering late last week of metal at 8.50c., St. Louis, by a large independent interest. This knocked the props from under the market and no recovery has taken place since. We quote the outside market at 8.50c., St. Louis, or 8.85c., New York, with the leading interest's prices unchanged at 9c., St. Louis, or 9.25c., New York. As soon as the situation rights itself and a recovery from the strike has set in, a higher market is predicted. It is almost impossible to buy a carload of lead in New York because so much metal is held up in transit. For small lots a substantial premium has been paid.

ZINC

The stagnation in this market continues. It has been aggravated if anything by the strike epidemic and prices are lower. Prime Western for early and second quarter delivery has been steadily declining and yesterday was quoted at 8.15c., St. Louis, or 8.50c., New York, with the possibility of 8c. at St. Louis. The weakness has also been accentuated by the continued selling here by British exporters of metal bought here and repurchasable on the other side at lower levels. London markets continue to decline also. Leading producers are uninterested in present prices and are doing very little business. Export business is also quiescent.

ANTIMONY

The market is quiet with Asiatic metal in wholesale lots for early delivery quoted at 11c., New York, duty paid, for the better grades and 10.75c. for the other. There is considerable conjecture as to what effect the industrial situation in Japan will have on the market.

ALUMINUM

Prices are unchanged at 33c. per lb., New York, for wholesale lots for early delivery of virgin metal, from the leading producer, with 31c. asked by outside interests.

ORES

Tungsten: Prices are firmer with low-grade ores at a minimum of \$7 per unit, but there is very little business. In this market strikes also have had their dampening effect. This, together with the uncertainty regarding the tariff, has made for a dull uninteresting market.

Ferro-tungsten is quiet and unchanged at 90c. to \$1.15 per lb. of contained tungsten. It is interesting to note that, according to official statistics, imports of ferro-tungsten and tungsten metal as powder for 1919 have been 396,460 lb. of which 340,964 lb. came in during the last quarter. During the War these imports were negligible, the exports predominating.

Molybdenum: The market is inactive and prices are nominal at 75c. per lb. of MoS₂ in regular concentrates.

Manganese: Quotations are unchanged at 65 to 80c. per unit, seaboard, for foreign ore, depending on the delivery. Advices from England are that a scarcity of tonnage is handicapping importers and that supplies in India are limited. The price for Indian ore is up to 4s. per unit, delivered British ports. This is about the same as the price at American seaboard at the present rate of exchange, 80c. having been paid here for early delivery.

Manganese-Iron Alloys: Prices are unchanged for ferro-manganese at \$200, delivered, for the American alloy for last half and \$195, seaboard, for a limited quantity of British alloy for shipment during August and later. Sales of small lots are recorded. The spot and early delivery price is unchanged at \$225 to \$250, the former applying to small lots of British alloy, and the other to American, with sales of small lots reported. Spiegeleisen is higher at \$75, furnace, as a minimum with demand moderate.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

A NEW DRILL-STEEL SHARPENER

A new drill-steel sharpener operated by compressed air known as the I-R No. 50 has been developed by the Ingersoll-Rand Co. This machine embodies a number of new and distinctive features, some of which are outlined below.

This sharpener was designed primarily to sharpen and shank rapidly and exactly drill-steel such as cruciform steel up to 2 in. diameter, or round, hexagon, octagon, quarter-octagon, auger, or spiral steel up to 1½ in. diameter. However, it has performed so many other tasks that 'drill-steel sharpener' is almost a misnomer. When fitted with special devices, it will forge bolt-heads, pins, stanchions, etc., in



Ingersoll-Rand Drill-Steel Sharpener

fact, nearly 200 different products have been made by this machine.

The single lever, which controls all of the operations of the machine, is fitted with a safety locking device. This prevents accidents because it is impossible to operate the machine unless the lock is released. The throttle-valve is of the balanced-spool type, operates easily and quickly, and is positive and instantaneous in its action.

The hammer-cylinder is an improved valveless type. This construction permits the free moving hammer to deliver exceedingly fast and powerful blows against the end of the dolly upsetting the steel and so forming the bits and shanks with extreme rapidity. This may be more easily understood when it is mentioned that its capacity is about 20% greater than the Leyner No. 5 sharpener.

The base must have sufficient strength to withstand the severe strains and shocks met with in its everyday work.

Sufficient attention has not been given to this in the past with the result that breakage was too common. A glance at the accompanying illustration will show how substantial and rigid is the base. It needs absolutely no foundation with the exception of a few plank to level it properly and is not even bolted rigidly to them.

Poor lubrication is due most frequently to the ordinary exposed sight-feed lubricator's being accidentally damaged or broken. The No. 50 sharpener has no sight-feed or other exposed lubricators. Efficient and positive lubrication is provided for the entire machine by the Ingersoll-Rand 'Heartbeat' lubricator. This is embodied in the throttle valve-chest casting and works automatically whenever the machine is in action. It is provided with adjustment for regulating the quantity of oil desired. This same idea is carried out throughout the entire machine. Every part is made for long, hard, continuous service. An example of this is the absolute elimination of all cup-leathers. Only accurately machined snap piston-rings are used. This will mean much to any man who has ever used a sharpener.

IMPORTANT COMBINATION OF TWO LARGE ENGINEERING AND CONSTRUCTION COMPANIES

Of general interest is the combination recently announced of the organizations of Westinghouse, Church, Kerr & Co., engineers and constructors, and Dwight P. Robinson & Co., constructing and consulting engineers, both of New York. The new company will be called Dwight P. Robinson & Co., Inc., and will occupy executive offices at 61 Broadway and engineering and designing offices in the Grand Central Palace, 125 East 46th street.

Dwight P. Robinson, president of the new company, was for many years president of the Stone & Webster Engineering Corporation, and formed his own company in 1918. He has had an unusually valuable experience in the design and construction of industrial plants, large central power-stations, and hydro-electric plants, and his company has specialized in work of this nature. At the time of the merger the Robinson company had large power-plants under construction for the Duquesne Light Co. at Pittsburgh, and the Penn Public Service Co. at Johnstown, Pa. Westinghouse, Church, Kerr & Co. was established thirty-six years ago, and has specialized in the design and construction of industrial plants of all kinds, railroad shops and terminals, and industrial power-plants.

The Westinghouse Electric & Manufacturing Co. is one of the largest stockholders of Westinghouse, Church, Kerr & Co., and the two companies have been closely identified for many years. To avoid what has seemed a handicap in procuring business by the latter company, on account of the belief of prospective clients that if they employed it as their engineer, they might be expected to purchase Westinghouse equipment; and also to permit the Westinghouse Electric & Manufacturing Co. to withdraw from any interest in the engineering and construction business, that being a field foreign to its normal activities, it was deemed in the interest of both companies that the above association should be

terminated. To accomplish this without embarrassment to other stockholders, and to their advantage, negotiations were initiated with Dwight P. Robinson, president of the Robinson company, looking to a merger. These negotiations resulted in the plan now declared operative, under which depositing stockholders will receive for their present holdings either cash or stock in the new company. It is believed that the new organization will become one of the largest and most successful in the construction and engineering business.

CUTTING WIRE ROPE

Proper provision for the protection of human life in mines demands frequent and regular inspection of hoisting cables by responsible persons and the employment of approved processes in effecting needed repairs. A section devoted to 'hoisting ropes' in the draft of a law to cover mine rules and regulations, proposed by the United States Bureau of Mines, is evidence of the extent to which the cutting of wire rope is now required in the maintenance of mine equipment.

The approved method of cutting the rope preparatory to re-socketing and re-clamping is the well-known oxy-acetylene process. There is no simpler or easier way. A typical outfit that has been found dependable comprises a standard 'Oxweld' cutting blow-pipe, a Linde oxygen cylinder, and a tank of 'Prest-O-Lite' dissolved acetylene. With this equipment a competent operator cuts through a two-inch cable in just about two minutes. The cutting apparatus is portable, so that it may be easily set up anywhere at a moment's notice.

The saving in time and expense in the cutting of rope may very profitably be extended to discarded rope, which may be reduced to lengths for use in other ways. By adding the welding blow-pipe to the equipment noted above the mine is provided a complete outfit for the speedy repair of broken machinery, making it unnecessary to depend on machine-shop repairs or costly replacements.

FREE TRIPS TO SULLIVAN PLANTS

By S. B. King

Hundreds of mining and engineering school students in all parts of the United States are being taken on trips to the Sullivan Machinery Co.'s plants in Claremont, New Hampshire, and in Chicago so that they may see just how drills, coal-cutters, air-compressors, and drill-sharpener machines are made. This summer thousands of miners and engineers, who have been using Sullivan machines, will make the same excursion, to view the 'home life' of their mechanical friends. The students, engineers, and workmen will be Sullivan guests, the company to bear all expenses. And it will not cost Sullivan company so very much because the guests all make the trip via the 'Film Rapid Transit'.

The Sullivan company believed workers and engineers would have an even greater appreciation of Sullivan machines if they could be shown where and just how the machines are made. It being impossible to get the thousands of men to the plant, it was decided to place the plants aboard the celluloid magic carpet and take the industries around to the men.

The Sullivan picture opens with panoramic views of the Claremont and Chicago works. The movie audience then visits the interior of the Claremont foundry and sees the pouring of air-compressor castings. The air-compressors, made at both the Claremont and Chicago plants, are then followed through the various stages of machining, assembly, erection, and the final testing at full speed and load before shipment. Interesting details include the gigantic planer at Chicago on which twelve angle-compound compressor frames are planed at one operation; the assembling of wafer valves and of finger valves used in the different compressors; and

the steam-valve action on one of the company's 2500 Corliss compound air-compressor in which the operation of the Corliss valve-gear is clearly shown.

The second part of the picture is entitled 'How Hammer Drills are Made'. The fact is emphasized that the company's rotators, water-drifters, stopers, etc., are made not from castings but from solid billets of steel or from steel bars. The observer is shown the wonderful automatic machinery by which the different parts are milled, shaped, and ground to the exact sizes and close fits needed in this class of machinery. Materials are shown under test in the company's chemical and physical laboratories and also in the carbonizing and heat-treating department, in which rows of furnaces, flanked by quenching-baths of different liquids and at different temperatures, give the parts of the drills the necessary hardness and toughness to resist the terrific strain of pounding upon rock. This section of the film is completed by a trip to the company's quarries or proving grounds, where the completed machines are tested for air consumption and drilling speed under actual service conditions. Complete views are shown of the company's drill-sharpening machine and drill-heating furnaces for the better care and treatment of the drill-steel used in mining.

THE SMALLEST MINE LOCOMOTIVE

It is common occurrence for us to hear about exceptionally large sizes of things, while the 'largest ever built' is a familiar phrase. An article in a recent number of the 'General Electric Review' tends in the opposite direction and describes the smallest practical mine locomotive ever constructed. This locomotive was designed for underground service and to meet unusual conditions in mine-development work. It is rated at two tons, for operation on 20-in. gauge track, and at three miles per hour has an effective drawbar pull of 400 lb. Overall it measures 48 in. long, 34 in. wide, and 35 in. high, with a removable step and operators seat so that it can be run on a cage and hoisted and lowered to the different mine workings as the occasion requires. The two trailer trucks carrying the batteries are likewise of small dimensions. Two are required so that the locomotive can operate continuously, each of the trucks being equipped with 55 cells of type A-4 Edison storage batteries.

The locomotive is operating satisfactorily at the Real del Monte Rosario mine in Mexico. A special feature of this locomotive is the adaption to it of a motor which renders feasible the use of a single reduction gear-drive. The saving of energy in the elimination of gears, pinions, countershafts, etc., gives the locomotive a much greater radius of action on each charge of the battery.

COMMERCIAL PARAGRAPHS

The Erection Department of the Kansas City Structural Steel Co. has established camp at Avondale, Louisiana, preparatory to the erection of four 55,000-bbl. tanks for the Export Oil Corporation of Tulsa, Oklahoma.

The manufacturing and selling of Delco-Light products heretofore conducted by the Domestic Engineering Co. has been transferred to the General Motors Corporation, and will be operated under the name of 'Delco-Light Company'.

The Aldrich Pump Co., in 'Pump Data No. 52', points out a number of advantages in using its flexible-disc coupling for operating pumps and air-compressors. A coupling of this type absorbs the shock incident to starting and stopping, and to irregularities in the operating load. The Aldrich coupling is universal in its application, and is designed to take up any non-alignment in the setting of the motor, and thereby relieve gearing and motor from jar and vibration.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N.Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MAY 8, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

EDITORIAL	
NOTES	Page
THE MORALITIES OF JOURNALISM.....	665
Incidents in the course of the political campaign in San Francisco. Is it proper to refuse an advertisement from the other side? Should an editor decline an article because he does not agree with the opinion expressed therein?	
GOLD PRODUCTION OF THE WORLD.....	665
Incomplete statistics. South Africa maintains the rate of production. Canada shows an increase. The British dominions contribute 70% of the world's total yield. Diminution of output in the United States and probability of further decrease unless gold mining is assisted.	
DIRECTOR U. S. BUREAU OF MINES.....	666
Resignation of Van. H. Manning. His excellent record as Director. The choice of a successor: H. Foster Bain, Edward W. Parker, Courtenay De Kalb, and George D. Louderback.	
WAR MINERALS RELIEF	666
The right of appeal from the Commission. Mr. Garland's bill. Supplementary legislation. Senator Poindexter's bill. Character of the examination conducted by the Commission. The Chestatee case. Delay in making payments to claimants. Action of the American Mining Congress.	

DISCUSSION

REGISTRATION OF ENGINEERS	
By Arthur W. Stevens	667
Commendation for the proposed law. Criticism of section 13. A duly registered engineer should not be excluded from practice in other States.	
THE CONTRACT SYSTEM IN MINES	
By E. Hedburg	667
Experience at the Golconda mine at Kingman, Arizona. Details of the contract-scheme used. Provision for contractor who is not 'in ore'.	

PRECIOUS METALS IN OIL-SHALE

By Walter E. Burlingame.....	668
Roguary and quasi-technical knowledge. A little gold in certain shales; none at all in most.	

ARTICLES

THE ROMANCE OF MINING DISCOVERY

By T. A. Rickard	669
The typical story of Juan Bautista and El Rosario. An Australian melodrama. Exaggeration of the science of the prospector. Camp Bird. John Treadwell and the mine that bears his name. Perseverance and 'scientific prospecting' by James Douglas; the U. V. X. The Bunker Hill, the burro, and the law-suit—a story of bad faith. In contrast is the story of the partnership between Alexis D. Parker and Thomas D. Lockhart and their discoveries in Nevada. The Comstock Lode. John W. Mackay and Mike Burke. The prospector's best moment—when he finds the orebody.	

A RUSSIAN COPPER REFINERY UNDER BOLSHEVIK CONTROL

By R. G. Knickerbocker.....	677
The Kyshtim mine in the Urals. Low wages and rich ore. Gas-producers. Casting of copper anodes. Operations in the cell-room. Doré furnace smelted slime at intervals. Gold and silver bullion. Theft of precious metals. Measures taken to prevent stealing. Attempt to run plant under Soviet direction. The absurdity and the calamity of Bolshevism. Return to New York.	

DEPARTMENTS

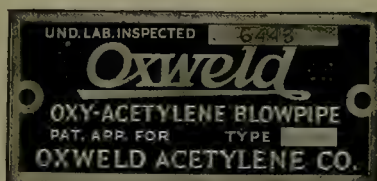
REVIEW OF MINING	683
THE MINING SUMMARY	691
PERSONAL	692
THE METAL MARKET	693
EASTERN METAL MARKET	694
BOOK REVIEWS	695
COMPANY REPORTS	696

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.

Another O. K. on a good Product



*Inspected and approved by
the Underwriter's Laboratories*

EVERY Oxweld Blowpipe bears the official stamp of approval of the Underwriter's Laboratories.

This is but another O. K. on a good product—the final step in the rigid system of inspections which Oxweld maintains for the protection of Oxweld users.

It is a significant fact that the welders and cutters of America—in whose hands lies the power of final O. K. on oxy-acetylene apparatus—have made Oxweld the largest producers of welding and cutting outfits in the World.

O-519

OXWELD ACETYLENE COMPANY

Newark, N. J.

Chicago

Los Angeles

*World's Largest Maker of Equipment for Oxweldin
and Cutting Metal*



T. A. RICKARD. . . . Editor

LIBERAL estimates by the U. S. Geological Survey place the world's production of coal in 1919 at 1170 million metric tons of 2205 pounds, which is the smallest output since 1910. The record year was 1913, when 1341 million tons, or 6.8% more than in 1919, was mined. Data on the production in the principal belligerent countries, which together contribute 85% of the total, show a decrease of nearly 30% in Europe as compared with only about 4.5% in the United States. Approximately 40% of the total supply comes from the mines of our own country.

WHAT the premium on gold has done for South African mining shares is indicated by a few quotations, the first figure being that of April 14 last year and the other the highest recent quotation: Central Mining, 8½, 12½; Crown Mines, 2½, 4½; Rand Mines, 2½, 5; East Rand, 5s. 9d., 18s. 6d. Incidentally, the fall in French exchange, together with the premium on gold in London, has stimulated selling from Paris, because, for example, Rand Mines shares were worth 84 francs a year ago and are worth 200 francs now. The German holdings were sequestered during the War.

GENERAL WOOD is a good soldier and an excellent citizen; all the more pity that the name and photograph of his son, Leonard Wood, Jr., described as "a chip of the old block and a go-getter with a record", should be used on an advertisement of an oil wild-cat in Texas. Another military officer's name is attached to the prospectus. Such commercializing by young men of an honorable name and an equally honorable record in the War is deplorable. The promoters of the Craven Oil & Refining Company may be 'go-getters', but they have a great deal of taste and it is all bad. Captains Craven and Wood will be well advised to cease exploiting their military records, or their family names, in such business.

FOREIGN trade with the United States continues to expand. During the first quarter of this year the total of our imports was at the rate of \$5,700,000,000 per annum, as compared with the annual average of \$1,160,000,000 in the decade ending with 1910. Moreover, our export business is increasing, despite the check placed upon it by the collapse of foreign exchange. In March our exports amounted to 820 million dollars as against 603 millions in the corresponding month of last year;

imports were worth 484 millions as against 267 millions a year ago; thus the so-called balance of trade was 436 millions, as against 336 millions in March 1919. This is a surprising and most agreeable result, having regard to the present unsettled economic conditions. At the current rate our foreign commerce this year will amount to 14 billion dollars.

PROGRESS is being made in the campaign for legislation to establish a National Public Works Department. A joint resolution has been introduced in Congress providing for the appointment of a committee of three from each branch of Congress to make a survey of the administrative services of the Government and to determine what re-distribution of activities should be made, so that each executive department shall embrace only those services that are closely related; and to prepare bills and resolutions having for their purpose the co-ordination of the functions of government, and its efficient and economical conduct. The response of the country to the propaganda in favor of a National Public Works Department has been such as to render members of both houses of Congress willing to accede to this preliminary investigation.

ON another page we publish an article describing the troubles brought upon the mining industry in Siberia by Bolshevik disorder. The writer, Mr. R. G. Knickerbocker, is manager for the Messina copper-mining enterprise in the Transvaal. At one time he was Assistant Professor of Metallurgy in the University of Cincinnati. Incidentally Mr. Knickerbocker gives many interesting details of technical practice at Kyshtim, including the use of producer-gas, the electrolytic refining of copper, and the employment of oil-burners in the doré furnaces. The impact of bolshevism upon a well organized and highly important industrial establishment is told in plain words, more eloquent than any rhetorical argument. To this is added a recital of Mr. Knickerbocker's personal experience amid the topsy-turvy conditions of Russian misrule.

CLEVER people sometimes do foolish things. For example, the supporters of the McFadden bill for granting a bounty on new gold are making a mistake in giving wide publicity to their so-called gold dinner, to which a number of rich men have subscribed. A hysterical evening newspaper in San Francisco has been pub-

lishing daily a list of subscribers to this affair. They consist of bank presidents, financiers, and rich mine promoters. One or two mining engineers are included, and we venture to express surprise at their willingness to endorse the scheme, for they ought to know that if the proposed legislation is to be pushed thus, apparently by the *haute finance*, it will not receive public support, because the stamp of class legislation will be placed upon it. Two reasons exist for supporting the McFadden bill: first, it will aid an honorable and old industry now crippled by adverse conditions; second, it will protect the gold reserve of the United States. The less splash the wealthy part of the community makes at this juncture, the better it will be for those directly interested in gold mining.

WONDERS never cease! At Kremmling, in Colorado, there have been found no less than "thirteen minerals, including alumina", so we are told in a 'special' to the Denver 'News', the mining editor of which is a trustee of the State School of Mines. What is even more remarkable is the statement that "alumina has never before been found in Grand county". Then the name of the county should be changed to Non-Mineral, in contrast to the existing Mineral county, made famous by Creede. "The analysis of the ore shows the alumina content to be 7.22%, worth \$25", but it is remarked that "the extraction process is said to be too expensive to justify working the ore for the metal at present". Hence the question, is it an 'ore'? It seems to us to be a mediocre portion of the earth's crust, suitable possibly for road-making. Besides alumina, it contains "gold, silver, copper, titanium oxide, iron oxide, manganese, magnesia, potash, zinc and soda". Why not whiskey and soda or something equally and archaically exhilarating? It is a sad and dry world, when we are given soda in which the 'stick' is zinc and magnesia and other effervescent piffle.

TO prove the need for a law compelling the licensing of engineers, a correspondent sends us an account of the Redondo oilfield by a gentleman who claims to be a geologist. However, a geologist is not an engineer, although some engineers are geologists. Evidently the geologists likewise must be licensed and registered and disciplined in the public interest. The Californian gentleman under fire found "skeletons of what was at one time coral reefs overlying the strike of the fault", which is much like putting a heavy weight on the angle of the parallax; or tying the meridian to the exhaust of a motor-car. Next, our pseudo-scientific friend found "conglomerate on the hills that are of a volcanic origin deposited at a time that part was submerged", which suggests cataclysmic conditions of a fearsome kind. He worked along the beach, beside the sad sea-waves, "to find the stratification which is dipping north" and he "also found a very rich strata of manganese". How singular, and yet how plural! He saw signs of oil and believes that "gas will be found in paying quantities at a shallow depth". So do we; it will be found right on the surface and it will come through an orifice lined with white pro-

jections of an osseous nature belonging to a biped of ruminating character.

SOME features of the present condition of the fuel-oil industry in its country-wide aspect are reflected in a statement of the Standard Oil Company, to the State Railroad Commission, apropos of its recent announcement of increases in price. The price offered for 'fuel crude' at the well has been raised from \$1.23 to \$1.48, simultaneously with an advance from \$1.60 to \$1.85 to the consumer. The statement specifically declares that need for additional revenue did not enter into the decision to increase rates. While we scarcely credit the Standard with viewing the additional income with distaste, we do think that it is sincere in its statement that the motives behind the advance are to stimulate increased production and to conserve the supply by limiting the use of fuel-oil. Since May 1915 the stocks of crude oil in California have decreased from more than 60,000,000 to 28,738,921 barrels on March 1, 1920. Of this less than 13,000,000 barrels is available today. At the present rate of consumption the surplus will have vanished in twelve months and the current supply will then automatically be diminished by 25,000 barrels per day. Conditions affecting the economy of oil are much the same throughout the country. The apparent remedy is the use of coal where it will serve the purpose, and intensive development of further oil resources.

A SIXTH member-society has become associated with Engineering Council, namely, the American Railway Engineering Association. The other members are the national organizations of civil, mechanical, mining, and electrical engineers, and the American Society for Testing Materials. The Association has 1650 members, so that the aggregate membership of the organizations represented on Engineering Council is now 45,000. Mr. Harry R. Safford, president of the American Railway Engineering Association and assistant to Mr. Hale Holden, president of the Burlington and allied railroads, will represent the newly affiliated society on the Council. Evidently Engineering Council is destined to fulfil the dream of a nation-wide organization of the engineering profession. We note that the Joint Conference Committee of the four founder societies in the Engineering building, New York, has issued a call to the engineering societies of the United States to assemble in an organizing conference to be held at Washington on June 3 and 4, pursuant to a resolution to that effect passed on January 23 at a joint meeting of the governing boards of the four founder societies and of the American Society for Testing Materials, as well as of the trustees of the United Engineering Society and the members of Engineering Council. The object of this convention is to promote co-operation between the various societies with a view to furthering the public welfare wherever technical knowledge and engineering training are involved. It is hoped to establish a national association of engineering organizations by means of a representative national council.

The Moralities of Journalism

During the present political campaign there has arisen question as to the conduct of newspapers in regard to the publication of matter coming from the party to which they are opposed. It is absurd to suppose that our local papers have any moral code answering to the term 'ethics', but it would appear that even a press so debauched as that of San Francisco has qualms as to the proper thing to do in certain contingencies. For example, the Hoover Republican Club sent an advertisement to the two morning papers. The 'Examiner' printed it and was paid for it. The 'Chronicle' declined to print it, because forsooth it was a "vilification" of its candidate, Senator Johnson. As a matter of fact it was a comparison of the records of the two candidates opposed to each other in the Californian primary election and contained nothing more than might be expected as propaganda from the side that submitted the advertisement in the usual way. The sensitiveness of the 'Chronicle' is amusing when we recall the fact that Senator Johnson said of its proprietor in 1916: "When there is a city to be pillaged, when there is a community to be robbed, when there is a man to be stabbed in the back, always lurking in the background can be found Michael Henri De Young." Next, it is claimed by the followers of Senator Johnson that the 'Bulletin', an evening paper supporting Mr. Hoover, "suppressed an entire article written by Mark Sullivan, the former editor of 'Collier's', who is writing a series on the progress of the campaign". When Mr. Sullivan "wrote an article showing that Hoover hadn't a chance on earth of getting the Republican nomination", the editor of the 'Bulletin' "squelched the whole thing", that is, declined to publish it. What a bold bad man! How about it? is it proper for a publisher to decline an advertisement with the sentiments of which he does not agree, and is it proper for an editor to reject an article that runs counter to his views? Are the two refusals subject to the same condemnation? Of course, not. The advertising manager of a newspaper is in a category with an innkeeper or a common carrier; he is bound to trade, always provided the purchaser of space is advocating nothing illegal and expresses himself in language that falls short of being obscene or otherwise contrary to law. Mr. De Young could not reject the Hoover propaganda because it was either libellous or indecent, for it was neither, and moreover, his own performances render ridiculous any squeamishness on his part. No, the advertising pages of a periodical publication are for sale, and sold they must be to anybody willing to pay the regular rate. Moreover, it was poor sportsmanship on the part of a newspaper that has been making characteristically the meanest kind of attacks on Mr. Hoover to refuse the retort proffered by his supporters. As to the action of the editor of the 'Bulletin', that is quite another story. The reading pages of a reputable paper are not for sale at any price; the editor is, or should be, the sole judge of the desirability of printing matter that is submitted to him; in arriving at a decision, he should appraise the article by its interest to his readers,

for his first function as an editor is to print what is interesting; to be interesting it must be true, for untruth soon ceases to be interesting to any but perverted minds. Again, an editor, if he have the spirit of sportsmanship, will publish views contrary to his own, particularly criticisms of his own utterances, because these are interesting to his readers—far more interesting indeed than expressions of approval or concurrence. We think the editor of the 'Bulletin' was within his rights in scrapping Mr. Sullivan's article, but he showed lack of courage unworthy of Mr. Hoover's cause. We would have printed it and then written a supplementary article to prove Mr. Sullivan entirely wrong.

Gold Production of the World

Statistics of production from the principal gold-mining regions of the world are now available. The British dominions report as follows:

	1919		1918	
	Oz.	£	Oz.	£
South Africa:	8,330,091	35,383,974	8,418,292	35,758,636
Rhodesia . . .	585,700	2,499,498	624,000	2,652,250
West Africa. .	292,500	1,240,691	307,950	1,333,553
India	461,171	1,959,976	485,236	2,062,253
Australia . . .	1,074,713	4,565,088	1,277,474	5,426,360
Canada	767,167	3,260,459	699,681	2,973,644
Other regions*	175,000	750,000	200,000	800,000
*Est.				
	11,686,342	49,659,686	12,012,633	51,006,696

We give the output in ounces and in pounds sterling, as published, because the variation in exchange and the fluctuation in the premium on gold render it impracticable to give the totals in dollars; however, if the total of fine ounces be multiplied by \$20.67, the grand total of production is \$241,556,689 in 1919, as compared with \$248,301,124 in 1918. The decrease is only 2.3% because the premium on gold stimulated mining in the premier district, the Witwatersrand, in South Africa, during the last quarter of 1919. In that year the United States produced 2,829,395 ounces, worth \$58,488,800, as against 3,313,373 ounces, worth \$68,493,500 in 1918. Semi-official statistics for Mexico indicate a decided increase of output in Mexico during 1918, namely, \$19,600,000, followed by a decrease to \$17,750,000 in 1919, as against \$7,690,000 in 1916. Further statistics are not available. In 1918 the "other" countries, including Mexico, contributed \$56,700,000 out of a world total of \$372,518,400, the decrease from the preceding year being equivalent to 17%. If the decrease was 12% last year, then their output was \$50,000,000. Thus the estimate for 1919 is:

	1919	1918
British dominions	\$241,556,689	\$248,301,124
United States	58,488,800	68,493,500
Other countries*	50,000,000	56,700,000
*Est.		
Total	\$350,044,489	\$373,494,624

It would appear therefore that the world's output of gold last year was about 350 million dollars, as against the record of 469 million dollars in 1915. This represents

a decrease of 25% in four years. It will be noted that last year 70% of the total was produced under the British flag; it is likely that the proportion will increase during the current year owing to the stimulating effect of the premium paid on gold in London. American production is likely to decrease to \$50,000,000 on account of the adverse conditions obtaining in this country, unless the proposed bounty of \$10 per ounce on new gold is granted by Congress.

Director U. S. Bureau of Mines

Resignation of Mr. Van. H. Manning as Director of the U. S. Bureau of Mines is announced, and it is stated that he is to become director of research for a newly organized American Petroleum Institute, composed of the leading oil producers of this country. The news of his resignation was anticipated, but is none the less unwelcome, because Mr. Manning has proved himself a conscientious and capable public servant. During his directorship the Bureau of Mines has gained greatly in importance, partly by reason of the rôle it played in war economics, partly on account of the general expansion of its normal activities. Mr. Manning has proved himself a worthy successor to his friend and former chief, the late J. A. Holmes, the first director of the Bureau. The selection of Mr. Manning's successor will be engaging the serious attention of the Secretary of the Interior and of the mining public, for the position is one of steadily growing responsibility and importance. The first name to suggest itself, of course, is that of Mr. H. Foster Bain, who acted as assistant to Mr. Manning during the War. He is now in the Malay States engaged in the examination of mines for private clients. His familiarity with the work of the Bureau of Mines, his high character and wide popularity, alike recommend him for consideration to the appointment. He has the engaging personality and mental qualities fitting him admirably to serve as a Federal official. It is possible, however, that the reasons prompting him to resign as assistant to the Director may militate against his acceptance of the major office. Among others whose names suggest themselves are Mr. Edward W. Parker, now director of the Anthracite Bureau of Information and formerly with the U. S. Geological Survey. Mr. Parker has proved his ability in several capacities. He also has the personal qualities desirable for an important public office and a wide acquaintance with the various phases of the mining industry. Another able man likely to be mentioned is Mr. Courtenay DeKalb, who did yeoman service for the producers of the secondary war minerals and proved his ability as a spokesman for the Western miner. As a writer and a scientist, of course, he holds a premier position. We venture to mention a fourth name, that of Mr. George D. Louderback, Professor of Geology in the University of California. He is honorably known not only locally but in Washington for his excellent work in connection with war minerals. He exhibited good sense, mental keenness, and skilful initiative during the trying times when it was necessary to stimulate and co-ordinate the production of the minerals most needed to

supplement the shortage caused by the lack of shipping and the exigencies of international conflict. We shall be glad to receive expressions of opinion on the subject, not for publication, but to guide us in co-operating with the leaders of the mining industry in recommending the best possible candidate for this important position.

War Minerals Relief

In our last issue we published the text of the measure introduced in the lower house of Congress by Mr. M. M. Garland of Pennsylvania. This bill (H. R. 13091) formulates the request of claimants under the War Minerals Relief Act for the right of appeal from the Relief Commission to the Court of Claims. The need for such supplementary legislation has been rendered evident by the fact that previous appeals made to the Secretary of the Interior were referred by him back to the Commission, establishing a vicious circle the absurdity of which was on a par with its unfairness. The measure has been introduced as a bill (S. 4259) in the Senate by Senator Poindexter, who is chairman of the Senate Committee of Mines, to which it has now been referred. It is a great pity that this remedial legislation, meant to correct a real grievance, should have been snarled so effectually in a tangle of conflicting purposes. The members of the Commission, headed by a mining engineer of the highest character and of unquestioned public spirit, have evidently been so anxious to prevent depredation upon the public funds and so eager to detect false claims for relief that they have exhibited undue suspicion of honest appeals and excessive inquisition into honorable enterprises instigated by officials of the Government during the critical period of the War. We have read the larger part of the volume containing the record of the hearings before the Mines and Mining Committee of the House of Representatives. Claimants, previously urged by Government officials to produce the necessary war minerals, were treated as if they were culprits under the law. The Mines Committee came to the conclusion that the Commission erred in its interpretation of the legislative intent and application of the provisions of the War Minerals Relief Act. In one case, that of the Chestatee Pyrites Company, identified with the Pratt brothers, in Georgia, it was shown that in ascertaining the ratio of concentration, which was under dispute, the representatives of the Commission calculated the ore that went into the mill in tons of 2000 pounds and reckoned the concentrated product in tons of 2240 pounds, thereby reducing the Pratt claim by \$58,000. As yet not \$1,000,000 has been paid out of the sum of \$8,500,000 appropriated for the purpose of relief, although the Act was passed on March 3, 1919. We are in agreement with the American Mining Congress, whose officers have stood loyally by the side of the miner in his proper effort to obtain the compensation voted by Congress, that a grave injustice is being done by the delay and inquisition to which valid claims have been subjected, and we hope therefore that the Garland bill will be passed without unnecessary delay.

DISCUSSION



Registration of Engineers

The Editor:

Sir—In your issue of February 14 I was glad to see a full account of the proposed law for the registration of engineers, architects, and land surveyors.

Already ten or more States have passed laws in which all of the above-mentioned branches of engineering are compelled to register and others are contemplating similar laws. It is only a case of a short time when practically all the States will have similar laws, and for this one reason, it is time that the engineers got together and drew up a law governing this feature. Under this proposed law, the standard of qualification is high, but they are such that any competent engineer can furnish. As I understand the purpose of this law, it is to eliminate as far as possible, incompetent men from masquerading under the guise of an engineer, and this is why the requirements are set so high.

There is but one criticism that I would like to make, and that is with Section 13, part 2, where it reads as follows: "Practice as a professional engineer, architect, or land surveyor in this State by any person not a resident in this State, when this practice does not aggregate more than fifteen days in any calendar year; provided, that said person is legally qualified for such professional service in his own State or Country." This part of the law practically excludes an engineer from making extensive examinations in any State other than the one in which he is registered without registering in this other State. As you know, this will compel all our engineers to register in many States other than the one in which they reside.

It appears to me that a law of this kind should be drawn up in such a way that it will allow engineers, architects, or land surveyors who are legally registered in any State, to practise their profession unlimited in any other State. Also, an effort should be made to the end that engineers, architects, or land surveyors who are registered under the laws of Canada be allowed to work in this country for a period of at least a month and a like courtesy should be extended by the Canadian engineers to men registered in this country.

As the law now reads, no engineer can practise his profession longer than 15 days in any State but the one in which he is registered. Should an engineer from California be called to examine a property in Colorado, or an architect or land surveyor be called to perform any duty under his calling, if this work took 15 days, which it undoubtedly would, he is excluded from further prac-

tice in Colorado unless he register in that State.

It is my opinion that this law should be changed so that any engineer, architect, or land surveyor who is regularly qualified and registered in his home State, be allowed to practise without limit in any other State or Territory, so long as he keeps up his registration at home.

ARTHUR W. STEVENS.

Atlanta, Idaho, March 27.

The Contract System in Mines

The Editor:

Sir—Regarding contract system of ore extraction, and general underground work, we have a fair example in the Golconda mine, at Kingman, Arizona.

In 1910, after a miners' strike organized by the Western Federation of Miners, the Union Basin Mining Company, John Boyle, manager, established the contract system for all underground work, which continued in force for about four years, and proved satisfactory to all concerned. The mine at that time was down to the 400-ft. level, the contracts, including all stoping and drifting, continued to the 600-ft. level. The ore-shoot was 1200 ft. long and from 6 in. to 4 ft. wide, the levels being 100 ft. apart, all work of drifting and stoping being done by single-hand drilling, and the ore mined was zinc-blende carrying gold.

Three classes of ore were produced, namely, first class, containing 50% zinc, was sorted carefully in the stopes by the contractors and sent out direct to the railroad for shipment to the smelter; second class, carrying 30 to 35% zinc, remainder silica, shale, and diabase rock, was sent to the mill at the collar of the shaft to be crushed and concentrated on jigs and tables; third class, assaying 15 to 30% zinc, also sent to the mill. The company operated the hoist, and furnished the tool-dressers or blacksmiths and all surface-workers. The contractors were given a block of ground, usually 50 by 100 ft., also a set of tools, such as picks. Drill-steel was weighed and each drill stamped with the contractor's number to prevent the mixing up in the blacksmith-shop or in transit. The tools were charged to the contractor by weight and number, so when he got ready to quit he was given credit for the return, or charged with any loss. All ammunition, such as powder, caps, fuse, and candles, was furnished by the company and charged to the contractor at cost. All timber and tram-rails, air-pipes, etc., were furnished by the company, which also attended to drainage of the mine.

The following scale for contract work was adopted.

Stopping and delivering first-class ore at the skip, \$4 per ton; second-class, \$2 per ton; and third-class, \$1 per ton. All ore was weighed at the top landing; the contractor's number accompanied the skip-load and was removed by the top-man, who duly credited the contractor with the weight. A grab-sample was taken out of each load and put into a sack marked with the contractor's number for assay. The top-landing man had to be an experienced sampler and a good judge of ore, as for instance, some first-class ore was not clean enough to be sent to the railroad-bin, so it had to be dumped into the mill-bins.

All drift-work was paid \$4 per foot, besides the price of the ore recovered as above stated. For each stull put in, \$1.50 was allowed; for half-sets \$2.50, for full tunnel sets \$5. There was no pay for handling waste when filling stopes. The contractor could hire his own help or go in partnership, as he liked. Wages were \$4 per day of 8 hours, and settlement and pay-day was once a month. At that time, 1911, there were 150 men employed in the mine, and the system worked so well that the company was able to pay a small dividend under a depressed ore-market, zinc being quoted at 5 cents per pound. Another advantage was the fact that shift-bosses were unnecessary. The men were satisfied, particularly the Mexican miners. The slogan at that time was 'No metal, no free holes'. Of course, the \$4 per foot paid in driving prospect-drifts kept the miner going until ore was found beyond the pinched part of the vein. He always had his board and lodging if he failed to open up the ore. The production of this mine under the contract system was 1500 tons per month of concentrate and first-class shipping ore, which netted at the railroad station \$25 after all expenses were deducted, including freight to an Oklahoma smelter.

E. HEDBURG.

Kingman, Arizona, April 17.

Precious Metals in Oil-Shale

The Editor:

Sir—Your subtle denouncement, in a recent editorial, of Mr. Elihu Palmer and his absurd deductions of precious-metal wealth in oil-bearing shale beds heartily meets the approbation of shale technologists and chemists who have had occasion to investigate or experiment along this line.

In the past few years I have made a score of investigations of so-called secret or special processes in which the inventor claimed a divine revelation purporting to extract the metals in a tenfold degree, where they exist, or making worthless rock the dream of Croesus. One would have to go deep into psychology for enlightenment as to the real motives of these individuals. Roguery seems the word. Nevertheless from personal contact with them I would likewise attribute such demeanor as the result of quasi-technical knowledge, perhaps from a half-year in college or from a complete newspaper or correspondence course. Such preparation, coupled with a wild imagination, constitutes their qualifications.

In an impersonal way, for the sake of comparison with

Mr. Palmer's assertions, I give you the result of an oil-shale represented as carrying over \$20 to the ton in gold. Said metal contents could only be extracted by a special process, and were detected only by their special method. This work was conducted with all eyes open in a neutral laboratory, and, *mirabile dictu*; the investigation was actually made prior to any investment. The findings were as follows: the sample of shale was crushed and quartered to a few pounds of $\frac{1}{4}$ -inch material. This was mixed, and a charge of 300 grammes was placed in the retort. This was treated in the hearth of a small stove with gradually rising temperature for one hour, at which time all kerogen was fairly well removed. The charge was then drawn, cooled, and ground to 60-mesh. It was then decarbonized by heating in an open muffle with intermittent stirring. The product at this stage was a light-buff in color, somewhat agglomerated. It was again passed through the screen, being ready for assay. It now showed 52% of the original weight. At this stage the metamorphosis has taken place. The gold is freed; only an aesthete could possibly know this.

Following came the determination of the gold by two separate methods, one the ordinary crucible assay, and the other by Winner's method, a concoction of several well-known commercial processes now in vogue, with nothing to commend except the patience of the operator. And now the results: the ordinary method showed a value of 25c. per ton in the ash; Winner's method, 28c. per ton. These results reduced to the original shale represent 13c. per ton, by the ordinary method, while Winner's method gives 14 $\frac{1}{2}$ c. per ton. The above results are averages. Individual determinations by each method show an occasional higher result with a vast majority of the determinations nil. From a value of \$10 per ton to that of 13 $\frac{1}{2}$ c., I submit to you for computation the potential "in the hole" on whatever billions of tons you may choose.

You will understand, I am not decrying the shale beds of our State as a great potential resource, nor do I discourage the need of scientific experimental work for sound inductive reasoning and progress in the chemical and metallurgical arts, but such vagaries as you describe should be accompanied by the music of the spheres, and are not for this fair earth. Your timely article should reap the gratitude of the savants, not to mention the chagrin of the unregenerates.

WALTER E. BURLINGAME.

Denver, April 22.

TWO SMELTERS in New Jersey, two in New York, and one in California, which treat only zinc drosses and skimmings, use large graphite retorts of 600 to 800 lb. capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The many uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are sold for re-distillation. Secondary zinc varies in quality just as the zinc derived from ore does, but a part of the secondary zinc is reported to be of excellent quality.

The Romance of Mining Discovery

By T. A. RICKARD

*The finding of ore has ever been fortuitous, from that dim dawn long ago when Javan, the son of Japhet, stubbed his toe against a copper outcrop in Cyprus to the evening of a much later day when Juan Bautista, a Mexican herdsman, in Sinaloa, lost his rosary only to find the riches of El Tajo. The story is typical; Juan was chasing a stray sheep when his rosary, becoming entangled in a bush, was torn from his neck. Not stopping to recover it, he threw his hat to mark the spot; later, returning from the chase, in the twilight, he found his hat. It was too late to find the precious beads, so he camped for the night. After making a fire, he went to sleep. Awakening before dawn, he seized an ember to light a cigarette of cornhusk. As he did so, the light fell on something that sparkled; he picked it up and took it to his *patron*, who recognized it as silver. The fire had roasted the ore and released the metal. Nothing is said about the fate of the rosary, but the mining district that thus came into being is known now as El Rosario. It has produced millions.

Lucretius ascribes the first discovery of metals to the burning of forests, and attributes the formation of masses of metal underground to the running together of molten streams into the fractures of the earth. Diodorus Siculus records the finding of silver on the Iberian peninsula, now known as Spain; he relates how shepherds set fire to a forest in the Pyrenees and how the heat sufficed to melt the silver out of the rock. This Greek historian asserts that "the metal flowed in streams of pure silver". The natives did not know what it was and sold it to the Phoenicians, who knew most things that were known at that time. The action of these shepherds in employing incendiarism to clear the forest and make room for the grass to grow for their flocks reminds one of the practice of our Western prospector, who, until the Forest Service stood on guard to check him, would start a forest-fire in order to clear the underbrush and so expose the rocky surface to inspection.

The stories of discovery in the olden time all have a major element of the accidental. The silver of the Rammelsberg in the Harz was found by a noble hunter who had fastened his horse to a tree. The horse, as is the manner of that impatient animal, stamped and scraped the ground with his hoofs so as to lay bare the silver-lead mineral underneath the turf. The horse was named Rammelus; hence Rammelsberg. The hunter selected specimens of the silver ore and sent them to the Emperor Otho. Whether the Emperor admitted the hunter to a share in the subsequent mine, we are not told.

In 1170 a Bohemian passed through the forest that then covered the Freiberg district and sat down to rest. At his feet he noticed a stone that reminded him of the ore he had seen in the Harz. He put a piece in his pocket and had it tested. It proved to be galena, rich in silver. Thereupon he informed his comrades and they returned with him to exploit the lode from which the stone had been shed. A better version is given by Agricola, who says that the drivers of the carts that carried salt to Bohemia from the springs in Saxony noticed the galena exposed in their wheel-tracks after a rainstorm. This ore was like that of the Goslar district, where they lived, so they took some of it to be assayed. It proved richer in silver than the Goslar ore, whereupon they betook themselves to that part of Saxony where Freiberg now is and started mines of their own.

Here we have the beginning of inductive reasoning, which is the foundation of science. Huxley said that science was only organized common sense, and that is what those Bohemian teamsters displayed by their inference and by their action.

Next we turn to South America, where we shall see how the ignorant native by chance found some of the great ore deposits of the world. In 1545 an Indian was hunting deer on the slopes of the Cerro de Potosi, in Bolivia, when he took hold of a shrub to pull himself up a steep place. His weight uprooted the shrub and exposed a mass of native silver in the rock. About the year 1630 another Indian, a shepherd on the Cerro de Pasco, lit a fire on the mountain-side and found later that he had melted silver out of the rock underneath the ashes. That was the outcrop of a vein famous in Peruvian history, but now associated with an important copper-mining enterprise. The Cerro de Pasco furnished the Spaniards with a million ounces of silver per annum for three centuries; the yield of Potosi is estimated at more than four billion ounces of silver.

The two greatest mines in Australia had strange beginnings. The story of the Mount Morgan mine, in Queensland, is a melodrama. This golden quarry is on the original 'selection' of 640 acres taken up by Donald Gordon for grazing purposes in 1873. His brother Sandy, a shiftless fellow, was grubstaked by Burns & Twigg, who had a foundry at Rockhampton, 26 miles from Mount Morgan. Sandy Gordon told them about a big red lode on his brother's land, but he was a cheerful liar and they paid no attention to his tale. They sent him to the Morgan brothers, Ned and Tom, who employed him, and, being prospectors themselves, thought enough of his tale about the big lode to go and see it in July 1882. First they went to examine what Sandy called a silver lode and

*An address delivered before the International Mining Convention, at Seattle, on April 7, 1920.

then they did some prospecting on Donald's ground. They noticed some ironstone boulders in a stream at the foot of a rocky hill rising out of the tropical bush; the stream was Mundie creek, which flows round the base of Mount Morgan. They chipped a piece of the reddish rock, which they crushed and panned on a shovel. It was full of fine gold. They said nothing to Sandy about it, but returned home and proceeded to organize a syndicate, which included Thomas Hall, William K. D'Arcy, and William Pattison, all of whom became millionaires. To Burns & Twigg, from whom they had borrowed the services of Sandy, the Morgan brothers offered a share in the discovery for a 10-stamp battery. The offer was declined. Sandy Gordon died as he had lived. It is said that the Morgans paid him £20 and as much whisky as he could drink. Donald sold his land to them for £1 per acre, not knowing what was on it. He died of chagrin. The mine is still richly productive, yielding copper in the deeper workings, as well as gold. Up to the end of 1919 it had produced \$92,000,000 in gold and \$34,000,000 in copper, making a total of \$126,000,000, from which \$58,000,000 has been distributed in dividends. The pathetic story of Donald Gordon has been embalmed in verse by Brunton Stevens, an Australian. The poem is called 'The Lost Chance'. I give you one verse of it:

"Just to miss it by a hair-breadth—nay, not to miss it!
to have held it
In my hand, and ofttime through my fingers run the
swarthy ore,
Minus only the poor trick of art or science that com-
pelled it
To unveil for others' good the hidden value, and to
pour
On a thousand hearts the light of hope that shines
for me no more."

Broken Hill was discovered at about the same time. A rough black ridge, like a reef, rising above the level of the dusty plain, this great outcrop was ignored for many years by the 'boundary-riders', or cowboys, on the adjacent Mount Gipps 'station', or sheep-range, in New South Wales. When they began to surmise that the dark rock might mark the line of an orebody they guessed that it must be a tin lode. Samples were broken and assayed for tin, without result. However, they pegged a number of claims on the off-chance, for lumps of silver chloride—hornsilver—had been found on the surface not far from this Broken Hill, as they called the black ridge. That was in 1883. A syndicate of seven station-hands was organized, each contributing £70 to the fund for sinking a shaft in search of silver ore. Of course, this shaft was started at the leanest spot on the outcrop; only a low-grade lead-carbonate was struck. The original working capital was soon spent. Two members of the syndicate retired and the number was increased to 14 in order to raise more money. Sinking of the shaft was then resumed, and, toward the close of 1884, some rich chloride ore was cut at about 100 ft. in depth. The shares had gone to a discount. The story is told that McCulloch, the manager of the station, played euchre with Cox, one of his partners in the prospect, to determine whether he

should sell one of his three shares for £100 or for £150. McCulloch won, and sold for £150 a share that six years afterward was worth £1,250,000. An engineer told me, when I was in Melbourne in 1889, how he went to Broken Hill, at the time when the first shaft was being sunk, to advise a client as to whether he should buy a share in the syndicate. On arrival at the prospect he found the superintendent absent and the men would not allow him to go underground. He took some samples of the rock on the dump and had them assayed at Adelaide, with an unsatisfactory result—only 16 ounces of silver per ton. The rich ore had been struck the very day of his visit, and if he had been more adroit he might have elicited the information from the miners.

In both these Australian stories we see the rudiments of scientific investigation. The science is thin indeed, but the use of the pan or the crucible to determine the presence of gold or silver marks the beginning of methods that are now established. The blindfolded goddess Fortune has had her bandage loosened so that she can glimpse the way she is going. Mining becomes less of a lucky grab into a half-opened sack and more nearly a systematic study of the signs that indicate mineral riches. "Science moves but slowly, slowly, creeping on from point to point."

In later days it has become fashionable to impute to science an exaggerated share of the credit for the discovery of mines. I recall two examples in Colorado: the Independence and the Camp Bird. The discovery of the Independence vein by W. S. Stratton resulted from the desultory prospecting of a carpenter. He had had a little experience in the Silverton district and was living at Colorado Springs when Cripple Creek came into prominence early in 1891. After trying several places in the district, he found a little gold in the broken rock covering the southern slope of Battle mountain, but his pannings led to nothing, because he did not know enough to test the outcrop of mineralized granite that was the one conspicuous feature of the hillside. Finally, at a loss what to do and noting the fact that the proportion of gold in the surficial debris diminished at about this point, he broke a piece of the granite and took it with him to Colorado Springs for assay. It assayed 19 ounces of gold per ton! That was on July 3, 1891. He returned next day and located two claims, the 'Fourth of July' and the 'Independence'. The Independence was the only vein in the Cripple Creek district that had an outcrop and it was one to which any intelligent prospector would have been attracted at once. The feldspar and mica had been decomposed and in their place were iron oxide, sericite, and gold. Stratton's only experience had been with the white quartz veins around Silverton; so he spurned what he called the "rotten granite", simply because he knew no better. When the Independence became famous his friends fabricated a yarn in which his knowledge of chemistry and mineralogy supplemented his energy as a carpenter so effectively as to give him the pose of a scientific explorer. One correct inference, however, must be allowed: when the float, or 'shode', as a

Cornishman would say, panned poorly, he recognized that he had passed the source of the gold; he looked up, as it were, and saw the granitic outcrop, surmised its possible agency in enriching the breccia on the hillslope, and broke a sample. Let us give him credit for that. The Independence yielded \$22,000,000, of which \$10,000,000 was profit, divided between owners, tributers, promoters, and ore-thieves.

The Camp Bird mine is in Imogen basin, near Ouray, a lovely summer resort in south-western Colorado. The discoverer, Thomas F. Walsh, also had been a carpenter when he obtained his first experience of mining at Leadville. Later he had done well at Cripple Creek. In 1896 he was running a little smelter at Silverton and needed quartz to mix with the pyritic copper ores of Red Mountain. He was looking for silicious ore. For several months he had been opening up a silver-lead mine, called the Hidden Treasure, in Imogen basin, and on one of his periodic visits, in July 1896, he happened to notice some pink spar in the dump at the mouth of an abandoned tunnel. He thought this pink spar was fluorite, with which he had become familiar at Cripple Creek, where he leased the Summit and Deerhorn mines from Stratton. Walsh told Andy Richardson, a prospector in his employ, to take a look at the old tunnel from which the pink spar had come, but nothing appears to have happened. In September he examined these old workings himself and took some samples, which he sent to Ouray to be assayed. They showed several ounces of gold per ton. More samples were taken and sent to Leadville for assay, with confirmatory results. Walsh kept this information to himself and set to work to secure title to the Gertrude claim, on which was the tunnel, as well as the adjacent ground, most of which he acquired by paying delinquent taxes. He located a claim next to the Gertrude and called it the 'Camp Bird'. Within four years he owned 103 mining claims and 12 mill-sites, covering 941 acres in all. By that time he had taken \$2,500,000 gross out of the mine and made a profit of \$1,650,000. He sold the mine in 1901 for \$6,500,000. During its life the Camp Bird yielded \$23,000,000, of which \$11,500,000 was profit.

On May 22, 1908, Tom Walsh gave an address before the Colorado School of Mines and recounted the story of his discovery in order to emphasize the value of technical science, especially mineralogy, to the miner. He told the students how he noticed a slide of "red pyritiferous porphyry" because it had "a very strong indication of gold in or near it". Samples of this rock assayed \$2 in gold. This "confirmed his suspicion" that there were gold veins in the vicinity. Among the claims acquired by him in the hope of obtaining silicious ore for his smelter at Silverton was one near the "porphyry slide"; he suspected that the vein on which this claim was located must pass, as he said, "through or near the porphyry dike and that it carried gold". So he went to get some samples and found "a dump of very showy ore, having zinc, lead, and some copper pyrites". He concluded his story thus: "I went inside and examined the vein. There I found an 18-inch streak of the same kind of ore

that was on the dump. Between it and the hanging wall there was about three feet of modest-looking quartz. As I examined it closely I saw little specks and thread-like circles of glistening black mineral all through it, which experience told me was gold in a telluride form". Samples of this quartz assayed "as high as \$3000 per ton".

This version of the discovery interested me greatly when I read it in print, because it was not the story that he had told me himself, in the presence of Andy Richardson, as we stood within sight of the old Gertrude tunnel in July 1900. I had taken down the real story in my notebook and therefore did not have to trust that most dangerous recorder, the memory. You have listened to the original version already and can make your own comparisons. The pink spar that aroused his interest was not fluorite, but rhodonite, the silicate of manganese. Thus his incentive toward inspection of the vein was founded upon an error; the analogy with Cripple Creek was false, but it served its purpose, which was to prompt the taking of a sample. The telluride of gold, calaverite, is not black, it is a bronze-yellow mineral, like chalcopyrite, but easily distinguishable from copper pyrite by its hardness, streak, and more brilliant lustre. The description of the black threads of glistening mineral is based upon information of a much later date, when it was ascertained, thanks to microscopic examination by C. W. Purington and others, that the black filaments in the Camp Bird ore consisted of free gold, galena, blende, and occasional traces of a telluride, the identity of which was never determined with certainty; in any event, it was not recognizable by the naked eye and bore no likeness either to the calaverite or the sylvanite found at Cripple Creek. Walsh deserves credit for taking samples and having them assayed. That was a test more trustworthy than any surmise based upon a half-baked mineralogy. What is more, he owed his luck to the failure of a predecessor to use the assay-test thoroughly. The romance of the Camp Bird belongs to Walsh, the pathos to William Weston. The Gertrude claim was located by Mr. Weston and George Barber in 1877 and formed part of the property acquired by the Allied Mines company in 1878. The workings found by Walsh in 1896 were made by H. W. Reed and Caleb Reed in 1884. Mr. Weston was manager for the Allied Mines, a wild-cat enterprise upon which Rossiter W. Raymond reported adversely in 1878. Andy Richardson told me that on the window-ledge of the log cabin that served as an assay-office for the Allied Mines company he found a piece of ore identical with the rich samples that Walsh had broken in the Gertrude tunnel and that gave him a key to the fortune of a millionaire. It is evident that his predecessors had failed to assay the ore for gold. Silver mining was then in vogue in Colorado. The ore was tried for silver alone and the assayer had failed to part the button. Others, possibly Mr. Weston, possibly Mr. Reed, had held the ore in their hands and had even ascertained that it was relatively poor in silver. For lack of a complete assay they had missed the chance of a lifetime. Perhaps they are luckier for it, who can tell? Walsh crossed the range many years ago; they live and

are honored citizens, the one at Denver* and the other at Salt Lake City.

Two carpenters who build better than they knew, not ordinary houses, but castles in Spain, have been mentioned. They dreamt they dwelt in marble halls and found themselves less comfortable than in the log cabins of their prospecting days. Another adventurous carpenter was John Treadwell, who gave his name to the Alaska Treadwell mine, which produced \$39,498,215 in gold and paid \$15,785,000 in dividends before (on April 21, 1917) the waters of the sea drowned the workings and stopped further digging. The locator was Pierre Erussard, a French Canadian, known to his friends as 'French Pete'. He lived with the Indians, as many prospectors have done. When the news came to Sitka, then the capital of Alaska, that gold had been found near Juneau, Pierre started forth in a canoe, accompanied by several Indians, one of whom was his wife's brother. They landed on the beach of Douglas island in November 1880 and found gold in the sand. Pierre looked for the source of this gold and discovered an outcrop of quartz that panned fairly well; it was on the hillside about a quarter of a mile from the shore. He located two claims; one of them he called the 'Paris', after the capital of France, which in turn was named after an ancient disturber of the peace; the other he named the 'Bear's Nest', because he found the ground occupied by a bear and her two cubs. The frosts and the thaws of a wet climate had disintegrated the outcrop so that Pierre could shovel the broken quartz into his sluice-box. Later he drove a shallow tunnel into the hill so as to cut the lode a few feet below the moss-covered surface. That was the beginning of the Treadwell mine. Pierre did pretty well by washing the softer and surficial portion of the lode in his rocker and sluice-box, but it was no bonanza, compared with the riches gathered on the mainland, two miles distant on the other side of Gastineau Channel. The diggers on Gold creek were making money faster, so Pierre sold one of his claims a year after his discovery. The record says: "September 13, 1881. Transfer of Paris lode from Pierre Joseph Erussard (or 'French Pete'), original locator, to John Treadwell, in consideration of the sum of five dollars (\$5.00)."

The purchaser, John Treadwell, was a builder and contractor with some experience in mining, for as early as 1869 he had worked in White Pine county, Nevada, and for 12 years before going to Alaska he had been engaged both in quartz and hydraulic mining in Nevada and California. At the time when Pierre was at work on the shore of Douglas island, Treadwell was building a house for John D. Fry, a banker in San Francisco. To Colonel Fry and his friend James Freeborn there came the story of a rich prospect in the range behind Juneau. Looking around them for a man whom they could send to investigate, they selected Treadwell as being both trustworthy and sufficiently experienced in mining.

*I regret to record the fact that Mr. Weston died on March 30, after the above was written. See 'M. & S. P.', April 24, 1920.

Moreover, he had been hurt in an elevator accident and needed a change of air. They agreed to pay Treadwell's expenses and to give him a fifth interest in the mine, if the purchase was recommended. Treadwell went north, examined the prospect, and found that it was only a stringer of quartz carrying a little free gold—just the sort of show to beguile a 'tenderfoot'. Treadwell saw that most of the rich ore had been dug out. Disappointed, he decided to return to San Francisco, but to do that he had to wait for a steamer. While waiting at Juneau he met Pierre, who had opened a small store in this pioneer settlement and happened to need a little ready money to pay for freight on goods that had just arrived from the south. He wanted \$300, for which he was willing to trade an interest in his claim on Douglas island. Without going to see the claim, Treadwell 'took a flyer', and advanced \$300 out of the funds intended for the purchase of the other prospect. Then he went across the strait to see what Pierre had in the way of a mine. Treadwell liked the look of the lode and took a bond on the Paris claim for \$20,000. Still awaiting a steamer to take him home, he spent his time in testing the prospect by panning. He remained two weeks at Pierre's cabin. Just before leaving, he told his host that the ore was too poor, and suggested that if Pierre would give him a quit-claim deed for \$5 he would try to sell the mine in San Francisco, with a promise to trade at Pierre's store if a sale were consummated. The deal was made. Treadwell departed, returning on May 17, 1882, with a five-stamp mill, which he erected on the Paris claim. His backers, Fry and Freeborn, carried out their agreement and organized the Alaska Mill & Mining Co., in which Treadwell obtained a fifth interest. Within five years the mill was enlarged to 120 stamps and in 1899 there were 540 stamps at work, the production in that year being 250,408 tons, yielding \$677,655 in gold. In 1890 the property was transferred to the Alaska Treadwell Gold Mining Company. Up to that time the mine had produced 617,112 tons yielding \$2,339,398, or \$3.79 per ton. The purchase price was \$16 per share for 100,000 shares, so that Treadwell's interest brought him \$320,000, besides his part of the dividends that had been paid during the preceding eight years, namely, \$650,000. So the Paris claim brought him \$450,000 in all. He made a small fortune (\$600,000) by the sale of a quick-silver mine to D. O. Mills, who acquired a large interest in the Alaska Treadwell also; in short, John Treadwell became a veritable millionaire. He lost most of his capital in the Tesla coal venture near Stockton, California, in 1906; but he did not go under; on the contrary, he is still active in mining and financial affairs in New York, although he is now 80 years old.

Among the romantic mineral discoveries of recent years I like to instance the United Verde Extension, known as the 'U. V. X', at Jerome, in Arizona. The story of this remarkable find of copper is pleasant to tell because it illustrates the more scientific methods of a later day. It is true, a large element of guess and of accident still survives even in the least fortuitous pros-

pecting, but it is satisfactory to see how reasoning from ascertained facts will guide an intelligent man to the uncovering of treasure underground; in short, mining becomes mining engineering.

The old United Verde mine at Jerome has produced 5000 tons of refined copper and has made a fortune for W. A. Clark, formerly senator from Montana. This mine is on the side of a mountain, the flank of which is traversed by a big fault that throws the ore-bearing formation vertically downward about 1700 ft. and horizontally about 900 ft. To the miner this is a serious dislocation, because it has placed the lower portion of the favorable formation beyond his observation except by shaft-sinking; he has no outcrop or other surficial signs of ore to guide him in prospecting. The ore in the United Verde is found in schist where it is penetrated by tongues of diorite. The schist below the fault has been covered by later sediments, now consolidated into beds of sandstone and limestone, these sedimentary rocks being covered in turn by a flow of basalt. Although the existence of the fault was detected in the early days of the district and it was deduced by those who understood geology that the continuation of the ore-bearing schist and diorite was to be found somewhere deep down in the earth, if only it could be reached, nevertheless to do that involved a good deal of expense; the depth to be penetrated was not known accurately; and when the favorable formation was reached it would still be necessary to look for an orebody as if it were a packet of needles in a haystack. It was a long shot and a hazardous venture. Nothing was done for a long time. The United Verde paid its first dividend in 1892; the search for its brother deposit of copper was not started until 1900. In that year a surveyor named J. J. Fisher commenced the sinking of a shaft on the 'Little Daisy', a fractional claim just below the line of the fault. Fisher died before his hopes were fulfilled. Louis E. Whicher continued the exploration and acquired sufficient ground to justify an expensive enterprise. The shaft was sunk through the basalt and the underlying sedimentary rocks into the schist; at 800 ft. patches of copper ore were found, but not enough to make a mine. This was in 1911. Already eleven years had passed and \$500,000 had been spent. Several mining geologists examined the ground and reported adversely. They thought the chances too slim.

At this juncture James S. Douglas was invited to take a hand; he made an inspection of the evidence available and was favorably impressed. In the summer of 1912 Mr. Douglas and George E. Tener took hold of the venture and raised \$250,000 as working capital. In the letter that they sent to their mining friends, inviting them to subscribe, they stated: "Mr. Tener and Mr. Douglas are not asking their friends for subscriptions, but believe that their plan for the development of the United Verde Extension Mining Company's property will result in the discovery of valuable orebodies, and in sending you this letter, it has occurred to them that you might consider it a favor to be permitted to join in a speculation which they recommend as such." What a contrast to the

phrasology of an ordinary prospectus! The friends, most of whom were experienced and successful mining engineers, did consider it a "favor" to be let into the deal and sent their subscriptions cheerfully. Mr. Douglas is the son of James Douglas, who died two years ago, a man whose name is synonymous with honorable and intelligent mining enterprise. The father, who, as you know, was identified with Phelps, Dodge & Co., was one of the subscribers to his son's venture; so was his brother, Walter Douglas, likewise distinguished in mining, especially in Arizona. James S. Douglas, the discoverer of the U. V. X., is a Western man of the best type, big and strong, mentally as well as physically, outspoken and direct, unconventional almost to a fault, but absolutely dependable. In June 1913, as soon as the requisite funds had been collected, he started a new shaft, at a point 1900 ft. east, and farther from the fault, than the Little Daisy shaft. The new shaft was sunk to 1400 ft. and connected with the old one. Cross-cuts were extended in search of ore, but unsuccessfully. Soon all the money of the company was spent. The shareholders were asked to subscribe for additional stock, upon which \$50,000 was realized. Douglas and Tener underwrote the issue. This \$50,000 likewise was spent, and still no ore was found. In the fall of 1914 Douglas and Tener, not caring to call upon their friends again, advanced \$25,000 of their own money to continue the work. They engaged a distinguished geologist to tell them where they had erred in their exploration. This gentleman advised them to cease operations; and it looked very much as if the advice ought to be taken. However, as the Cornishman says, "Never abandon a drift until you have driven twenty feet farther." Douglas decided to persevere a little longer, and in December 1914 a cross-cut that was being extended toward the centre of the U. V. X. ground, from the main level at 1200 ft. connecting the two shafts, cut five feet of 45% copper ore. From this orebody about \$600,000 worth of copper was won during 1915. But the best was yet to come. The prospect had become a mine, but it was destined to be a bonanza of the very first class.

A drift was started 200 ft. below, on the 1400-ft. level, to get under the orebody, but it went beyond the point where the ore was expected and found nothing. A heavy flow of water hindered exploration; large pumps had to be provided before the work could proceed. Then a cross-cut was driven each way from the drift on the 1400-ft. level, but both branches drew a blank, because, as was ascertained later, the orebody had taken a decided dip westward. Another cross-cut failed; but the third struck 16% ore at 40 ft. from the drift and continued in ore for 200 ft. more. This was *not* the orebody cut previously on the 1200-ft. level; it was another and a bigger one, which proved to be 260 ft. wide and 440 ft. long. It reached upward to 40 ft. above the 1200-ft. level; between 1250 and 1500 ft. there was estimated (in 1917) to be 2,000,000 tons of 15% ore, representing 600,000,000 pounds of copper. Besides this chalcocite ore, the product of secondary enrichment, there is about 1,500,000 tons of primary 5% pyritic ore from which further profits will

be derived. The bonanza promises to yield 3,500,000 tons of 10% ore. In the following year (1916) the U. V. X. produced 36,402,972 lb. of copper from 77,461 tons of ore, an average of 23.5% copper, besides 2570 oz. of gold and 128,468 oz. of silver, the total output being worth \$9,949,918, of which \$7,400,000 was profit. Douglas struck it alright, alright! It was one of the most remarkably concentrated masses of chalcocite ever uncovered by the pick of the miner. When I saw a carload of it, just off the cage, at the surface, it looked to me like bituminous coal; it blackened the fingers. That carload assayed about 40%. In April 1917 the mine produced 4390 tons of 38% ore and 7029 tons of 26% ore, containing therefore 6,991,480 pounds of copper, worth 2,167,358 dollars.

This is a story of the kind of prospecting that must replace the gophering of an earlier day. To study the sunlit surface will not suffice, because all the obvious outcrops will have been found; it will be necessary to dig down into the darkness underground, steering by the light of scientific induction. That is what Douglas did. He had a good general idea of the local geology and of the structural conditions produced by the fault; he drew inferences from the signs of copper in the Daisy workings, more particularly the finding of a small patch of chalcocite, which indicated secondary enrichment, with the prospect of finding rich ore at a lower horizon. His experience of mining elsewhere in Arizona was helpful to him; it gave him the right feeling, or intuition; and on top of that he had courage, and more courage, as well as the money to back it. He has made a lot of money and it has not spoiled him. In this respect he differs from most of those whom our daily press calls "bonanza kings"—for the common scribe is so hard-up for epithets that he has to go for them to an outworn system. Of course, Mr. Douglas is an educated man, and that is why, among other reasons, the romance of his adventure has not had a sequel of pathetic demoralization, but, instead, patriotic effort during the War and enlightened public service at all times.

No story of mining discovery is complete without a reference to the Bunker Hill & Sullivan mine, in the Coeur d'Alene. Most of you have heard the tale and probably most of you are familiar with the fiction that has long passed current for fact. The version formerly accepted was that an old prospector lost his burro and found him standing upon an outcrop of galena; later, it is said, the men who had grubstaked the prospector claimed a half-interest and were awarded a share in the discovery because their burro had participated in the finding. Jim Wardner, in his book, even went so far as to put a fictitious decision in the mouth of the judge: "From the evidence of the witnesses, this Court is of the opinion that the Bunker Hill mine was discovered by the jackass, Phil O'Rourke, and N. S. Kellogg; and as the jackass is the property of the plaintiffs, Cooper & Peck, they are entitled to a half-interest in the 'Bunker Hill' and a quarter interest in the 'Sullivan' claim." This is fiction. By referring to the record of the case, I find that what Judge

Buck did decide was: "That the plaintiffs are entitled to a decree as against N. S. Kellogg and Phil O'Rourke for an undivided fourth interest of in and to the Bunker Hill mining claim, as described in the complaint as they held the same September 10, 1885, and all interest acquired since said date in and to said claim and judgment for costs against defendants." He said nothing about the burro; that animal served as a herring across the trail of dishonesty, yet for more than thirty years he was the hero of the tale or a hero with a tail. The glittering galena by which, according to Kellogg, he was hypnotized, resembled the "red" lobster described by the man who had eaten specimens of that succulent crustacean, but had never seen one alive. Galena, as you know, oxidizes readily when exposed to the weather; it loses its bright lustre, changing to the sombre sulphate or the dull carbonate, both these products of decomposition becoming reddened or blackened by the iron released from the oxidation of small quantities of pyrite associated with the galena. The outcrops of lead lodes in the Coeur d'Alene consist commonly of dark-red ironstone with gray anglesite (the sulphate of lead) or cerussite (the carbonate), in the midst of which small unoxidized cores of galena may survive. Neither the jackass nor his comrades saw any mass of silver-white galena on the surface of the Bunker Hill claim. The evidence indicates that Noah Kellogg found the outcrop of ironstone and located it. He chipped off a few pieces, including one or two that contained galena. When he showed his samples to O'Rourke, who had mined at Leadville, that wily son of Erin led him straight into temptation, namely, to evade his obligation under the grubstake. Only the ironstone was shown to Cooper and Peck, who had no use for such poor-looking stuff, and said so, thereby giving Kellogg an excuse for terminating his agreement. Thereupon Kellogg and O'Rourke re-located the Bunker Hill and the adjacent claims, but, unfortunately for them, the original and discarded location notice was found by Peck a few days later and gave a clue to their trick. The litigation was not ended when the mine was sold, and, in order to clear the title, the prospectors were paid a considerable sum of money, all of which they lost in a few years. They died paupers. The burro fared best. When superannuated he was placed on a farm in Oregon, where he died full of years and honors, even his burial being made the occasion for the expression of lofty sentiments in accord with the myth that had been concocted to his memory.

This is not a pleasant story; it is overcast with bad faith, as the galena was coated with dross. Yet I venture to say that such breaches of honor are rare among prospectors. If they were common, the custom of the grubstake would be discarded. That is obvious. I like to recall the story of the Florence mine at Goldfield. In 1883 Alexis D. Parker, who was then working as a laborer, for the sake of experience, on the Denver & Rio Grande railroad, grubstaked a miner named Thomas D. Lockhart; he continued to do so for 18 years; even when Parker was earning only a small salary as an accountant,

he managed to save enough money to back Lockhart in his prospecting expeditions, but without any noteworthy result. In 1901 Lockhart went to Tonopah and located two claims near the find that had been made by Jim Butler, who, as everybody knows, was the discoverer of that famous district in Nevada. Lockhart was informed that he had overlapped some ground already located, so he moved off southward and located two other claims. They were on the sage-brush plain: they showed no signs of ore, and their validity as locations might have been questioned. Meanwhile the work done on the Mizpah claim of the Tonopah mine indicated the strike of that vein, so Lockhart began to sink a shaft through the rhyolite that capped the ore-bearing formation. He started the shaft unaided; he would climb down to the bottom and fill the bucket; then, climbing to the surface, he hoisted it with his windlass. This shaft became the main opening of the Tonopah Extension mine and penetrated rich ore at 237 ft. In March 1902 Charles M. Schwab bought the Tonopah Extension for \$75,000 from Lockhart. For several years he had received no financial aid from Parker and he was entirely free from any legal obligation to give him any part of his stake, yet he lived up to the spirit of their comradeship and handed him \$37,500. After this start, Lockhart went to Goldfield, 24 miles from Tonopah, and acquired the Florence mine, paying \$7000 for a half, with an option on the control. George Wingfield and George S. Nixon took a lease on the Florence and the royalties they paid gave Lockhart the money needed to complete his purchase. Soon after he had made this deal, Lockhart overheard one of the owners chuckling over having got the best of him, but his confidence in the mine was not shaken. He told Parker about it, informing him that he need not come into the deal unless he wanted to do so. Parker replied that he would share equally with him in all his mining ventures. They did well.* The mine paid \$735,000 in dividends. Mr. Parker is now a director of the Colorado & Southern Railway Co. I heard from him last week; in his letter he says: "The pith of the story of the grubstake of Lockhart and me is that each gave of his best to the other. It is a story of absolute honesty. We never had any written agreement, each considering his word as good as a signed paper. What is still better, we kept our word. I did my part in furnishing the grubstake and in standing by Lockhart after we made our money. He never failed to put my name on all locations and to hand over to me an undivided half-interest."

The miner's pick never opened a greater treasure-vault than the Comstock, yet the story of its discovery is more sordid than romantic. In 1859, and for eight years previously, immigrants had strayed from the overland trail into the valley of the Carson and up one of the creeks to Gold Cañon. There they had obtained a scant living by desultory washing of the gold from the detritus in the gullies on the sides of Mt. Davidson, or the Sun Peak, as they called it then. They were an ignorant and

a shiftless lot. The gold that they saved and the 'black iron' that they threw away came from the outcrop of a great vein, but they had no notion of the relationship. The 'black iron', rejected with many an oath because it mixed with the gold in their sluice-boxes, consisted of silver sulphide (probably stephanite), but they did not know it. Slowly, inevitably, these placer miners worked their way to the disintegrated parts of the vein itself, where the diggings became very rich. The gold was pale in color, but there was plenty of it. To their surprise, the 'pay-dirt' led right down into the earth. They continued to dig and to wash out the gold, unaware that they were on the edge of the greatest ore deposit in the world. A passing stranger—a farmer from Truckee—took a piece of the discarded 'black iron' over the Sierra to Grass Valley, where he had it assayed. The stuff was nearly a quarter silver. Quietly this man and a few friends left that night on horseback for the new mines, then known as the Washoe diggings, where they bought out the discoverers for a song. The news spread; others came; then more and more, until within a few weeks hundreds were rushing across the mountains from California to Nevada. That was in June 1859.

The Comstock Lode, as the great vein was called, was from 150 to 500 ft. wide, and it could be traced along a bare mountain range for eight miles. Along the outcrop hundreds of claims were located, but the richest orebodies were found in a few mines in the central portion, within a distance of less than two miles. The total production of the lode was \$400,000,000 in gold and silver. Most of this came from a few large orebodies, called 'bonanzas', five of which had outcrops, some distance apart. The Con. Virginia bonanza, which was shared by the Con. Virginia and California companies, was discovered 1167 ft. underground; it yielded a million tons of \$100 ore and paid \$73,298,700 in dividends within five years, from 1874 to 1879. The stock of the Con. Virginia company sold for \$1 per share in 1870 and for \$780 in 1875. The finding of this orebody was the consequence of the persistent search directed by two stalwart and intelligent Irishmen, John W. Mackay and James G. Fair, who were at the head of an exploration company that worked for two years and spent \$200,000 in a part of the lode that previously had been unproductive. They found other orebodies in other mines. They were well rewarded. Mackay retired with \$20,000,000, and Fair with something over half that amount. They deserved it. Mackay possessed unusual administrative ability and won the absolute confidence of his associates, in fact, of all who came in contact with him. Fair had a genius for finding ore; they used to say at Virginia City, "Jimmy Fair has a great nose for ore". Mackay went to New York and became one of the big men in world finance. He and James Gordon Bennett laid a new cable across the Atlantic and established the Postal Telegraph Cable Company, the control of which rests now in Mackay's son. Mackay was a big man, physically and mentally, a king among men, dependable, self-contained, strong-willed, untiring, but he bore his part in modest and kindly

*Lockhart died at Los Angeles on June 19, 1914. He was 65 years old. His personal property was valued at \$350,000.

fashion. He had no greater pleasure in life than in doing kindnesses. Fair retired to San Francisco and invested his money largely in real estate. Tradition does not record that he was ever 'touched' by his old-time comrades.

The miner is proverbially a man with an open hand, and the successful ones are literally besieged for loans and assistance by old and new friends, until the giver may be forgiven for feeling that they seek him for no other purpose. The observant cynic begins to wonder if there be such a thing as disinterested friendship. This is the saddest part of being a mining millionaire. Such loans are seldom repaid; on the contrary, the "loan oft loses both itself and friends", as Polonius puts it. John W. Mackay, for example, was most liberal to his old friends, and they abused his generosity. He saw it clearly, but his tolerant spirit saved him from misanthropy. A noted gambler, who had known Mackay when they were young fellows together at Downieville, borrowed \$5000 at a time from Mackay and so often that the total reached \$50,000. When he came for the last 'touch', Mackay asked gently, "Say, Joe, what is your limit anyhow?"

It was one of Mackay's chief regrets that fortune separated him from some of his most valued friends, among them Mike Burke. At Mackay's request Mike came from Placerville to San Francisco once or twice, but Mackay's office was so thronged with self-seeking men whom Mike despised that he could not be induced to come again. Mackay used to say, "Mike Burke won't associate with me since I became a millionaire".

Most of the discoverers of mines—and I have known many of them in many lands—have profited but little from their apparent luck. By "profited" I do not mean financially, although not many retained their suddenly acquired wealth for long; I refer to the larger profit of happiness. What shall it profit a man if he gain a bonanza and lose his health, his friends, or his purpose in life? Some of my friends who lived on bacon and beans, on flapjacks and camp coffee for ten or twenty years, and retained a vigorous manhood, succumbed easily to French cookery, to small hot birds and big cold bottles. It is better to be a healthy prospector than a dyspeptic millionaire or even a bilious billionaire. It is the penalty of sudden wealth that it throws a man into a new acquaintance; he loses the good friends of his poorer days, often not from snobbishness or any willingness to be separated from them, but simply because a new and costlier way of living creates a barrier between one set of companions and affords a bridge to another set. Comradeship is largely dependent upon propinquity, similarity of tastes, and the sharing of the same daily experiences. The prospector loses his pals when he moves from the log cabin to the brownstone mansion or the marble hall. Another factor of unhappiness is the loss of a purpose. To the prospector the search for the mine has a zest that goes when once the search is ended; his best moment is the one in which his pick pries loose the chunk of rich mineral or that in which the blast exposes a full stoping-width of

glittering ore. That is the moment of his achievement. To some it is permitted to see the sinking of shafts, the building of mills, and the realization of the dream of a greatly productive mine, but to most this sequel is denied because they have to forego ownership of their discovery. The peak of their curve is the actual finding; after that their portion is flat, stale, and unprofitable. My sympathy goes to the prospector when he is transplanted from the pine-clad mountains of his wide domain to the narrow streets of a crowded city. He is a fish out of water, a bird in a cage, a stranger in a strange land. His happiest moment is not when he has all that he can eat and drink, all the painted women that money can buy, or all the luxury that wealth can purchase. Robert Service has expressed the idea:

"The men who can't remember when they learned to swing a pack,

Or in a lawless land the quest began;

The solitary seeker with his grubstake on his back.

The restless buccaneer of pick and pan,

On the mesas of the Southland, on the tundras of the North,

You will find us, changed in face but still the same;

And it isn't need, it isn't greed that send us faring forth—

It's the fever, it's the glory of the game."

I think of the prospector as having reached the crest of his career when he climbs to the top of the range and looks on the other side, eyes wide with expectation and arms outstretched with eager hope, standing like Balboa "silent upon a peak in Darien", or like Francis Drake, who went forth from the quiet lanes of Devon.

"Not knowing if he went to life or death,
Nor caring greatly, so that he were true
To his own sleepless and unfaltering soul,
Which could not choose but hear the ringing call
Across the splendors of the Spanish Main
From ever fading, ever new horizons,
And shores beyond the sunset and the sea."

MEXICO's metal production from 1916 to September 1919, has been published in *Iniciativa de la Ley de Ingresos*. The following table gives the production for 1916, 1917, 1918, and 1919 (January to September). A kilogramme is equivalent to 2.204 pounds.

Metal	1916, kg.	1917, kg.	1918, kg.	*1919, kg.
Gold	11,748	23,543	25,313	17,208
Silver	926,142	1,306,988	1,944,542	1,462,255
Copper	28,411,248	50,985,923	70,223,454	38,170,209
Lead	19,970,986	64,124,752	98,837,154	50,533,765
Zinc	37,449,226	14,757,333	20,698,995	6,499,060
Antimony	828,767	2,646,544	3,268,548	470,778
Tin	292	9,214	13,537	1,588
Tungsten	12,250	187,637	149,486	21,969
Molybdenum			27,371	1,767
Manganese		73,387	2,878,383	2,137,484
Mercury		33,132	163,598	85,399
Arsenic		1,284,820	1,881,011	1,641,250

*January-September.

AMERICAN engineers engaged in reconstruction work have commented on the excellence of French mine-hoists. This machinery is made in France, and probably all the new hoists for the wrecked mines will be built in France, except for such purchases as the French may consider it advantageous to make in Germany.

A Russian Copper Refinery Under Bolshevik Control

By R. G. KNICKERBOCKER

The operation of a refinery in the Ural mountains during the first and second revolution (May 1917 to January 1918) was a difficult task. The disorganization attending the first revolution (April 1917) nearly destroyed all means of transportation of materials or supplies to the Kyshtim refinery, the only one in the largest country in the world. This same disorganized or chaotic condition of a heretofore iron-ruled people soon gave way to the radical Bolsheviks; wages advanced from 2 to 36 rubles for an eight-hour shift; the workman spent most of his time drinking tea and in conference with his neighbor upon the weighty question of how he was to rule his country; the authority of foremen and managers was discarded, and on November 5, 1917, the new government under workmen's, or Soviet, control confiscated all foreign capital and property, and attempted to operate some of the stolen property. It was at this time that the Bolsheviks arrested all engineers at the Kyshtim plant and tried to force them to operate it as they had been doing for the English company.

The Kyshtim estate consists of a timber and mineral tract of land about one-quarter the size of the State of Indiana. On this property the following plants had been in operation: Iron mines and blast-furnaces with foundries at Kaslee connected to Kyshtim by an inland lake; it is 35 miles from Kyshtim to Kaslee. Copper mines and smelter at Karabasch connected to Kyshtim by 30 miles of narrow-gauge railroad. Steel-plant, steel-rolling mill, nitric-acid plant, sulphuric-acid plant, dynamite-factory, and copper-refinery at Kyshtim, which is on a branch of the Trans-Siberian railway, 90 miles southwest of Ekaterinburg, the city where Czar Nicholas was supposed to have been murdered in the summer of 1918.

The commercial profit of the entire copper-plant from the mining of the rich sulphide ore to the finished bullion was dependent on low wages and extraordinary richness of ore. No ore was hoisted that ran under 5% copper; no concentrator was used. The fine was charged with coarse ore into the two blast-furnaces; the matte was charged to Pierce-Smith converters and blown to a low-grade metal. This was cast into slabs, 18 in. wide, 24 in. long, and 3 in. thick, and these were shipped to the refinery on the company's narrow-gauge railway. The fume-loss from the converters at Karabasch was very high and samples taken from the snow showed good colors. A rough test on this loss gave, over a period of three years, an average of 3% silver and 2% gold. These are percentages lost from the total matte charged to the converters. The American geologist in charge of Karabasch informed me that the miners were gouging out pockets of rich sulphide ore with no regard for safety or

the life of the mine; he assured me that the amount of low-grade sulphide was sufficient to more than warrant the mining and treatment of 3% ore.

The Kyshtim refinery consisted of a sulphuric-acid works, anode-furnace, cell-room, electrolytic slime-leaching plant and doré furnace, bullion refinery, and wire-bar furnace. This plant was built by an American engineer, H. Emerich, in 1907. He had not finished the plant as he had planned, and as I saw it in 1917 and 1918 the plant was run down considerably. When I was there a Russian, M. Bredech, was manager. The converter slab-copper from Karabasch was unloaded in the upper part of Kyshtim and carted by one-horse wagons, eight slabs per load, for three miles to the refinery. Here it was weighed, sampled, and charged by means of an air-lift trolley into the anode-furnace. This furnace, with regenerating-chambers, was fired by gas from a crude type of producer using wood refuse, such as tree-tops, pine needles, small branches and bark from the adjacent pine forests, the nearness of which can be seen from the photographs.

These Russian gas-producers have been mentioned by metallurgists as an interesting instance of the use of refuse material for the firing of reverberatory matting and refining furnaces. The matte-furnace at Karabasch was also of this type. At Kyshtim producer-gas from this refuse material was fired under boilers, generating steam for power, and also piped to the cathode and anode furnaces, where the combustion was satisfactory and there was never any trouble in keeping up proper heat. It should be noted, however, that the fuel fed to the producer was highly resinous, that the average haul by one-horse wagons or sleds was half a mile, and that the labor-cost at the time this plant was installed was the equivalent of 75c. American currency per day of eight hours for the teamster, who furnished his own horses and wagon. A continuous procession of wagons onto the charge-floor of the producer was necessary owing to the speed of combustion of the fuel. The hearth was 10 by 14 ft. The anodes were cast on a Walker anode-machine rotated by compressed air. Molds of cast-iron were used. The average weight of the anodes was 350 lb.; they were 28 in. wide, 36 in. long, and 1½ in. thick. They were cast thin on account of high contents in gold and silver, and had side lugs for support of the ordinary Walker type. The anode scrap averaged 12 to 20%, and the copper in the anode metal, 98.4 to 98.5%. (Note the difference from standard American anode purity.) Traces of arsenic and antimony were present. The number of men employed on the anode-furnace and in loading anodes onto industrial cars and unloading in the tank-house stock-room was approximately 15 to 20 per 24 hours.

The cost per ton of anode-metal for five months (revolutionary times) was 150 rubles, which meant \$75 per ton before the War, but the ruble at this time was worth only about 10 cents. Two-thirds of this cost came from the long haul from the railroad terminal in upper Kyshtim and the poor arrangement for handling the anodes after they were cast; they were stored in a long stock-room on the south side of the tank-house. The crane did not pick up anodes; they were loaded into the refinery cars by a motor-hoist, and the cars were then pushed to one side of the tank-house and the cranes picked them up on a home-made spider. This was an inefficient arrangement, especially when the load on the spider was unbalanced or an anode dropped; the light end went up and the entire load fell. The picking up of anodes from the stock and getting them into the cells took seven men and two cranes approximately four to five hours for every 16 cells or 160 anodes. The starting-sheets, which were of very poor quality, were placed in the cells by hand. They used a platform which rested on the cells and was moved by the crane; this took 10 to 12 men one hour, for 165 sheets. They used a vertical type of centrifugal pump, motor-driven and direct-connected, for circulation; for their upkeep they employed five mechanics, eight hours per day. Three pumps were in operation and nine undergoing repair—a poor arrangement. Later they tried the Pohle air-lift, and will probably use it. Cathode copper and scrap anodes were removed by hand onto cars, and by crane to the track running to the furnaces. Ten men working eight hours on the day-shift removed slime from 10 to 12 cells and carried it to the leaching-room. This operation from start to finish was the worst I ever saw. The crudeness of the method of handling this rich electrolytic slime was evident in the amount of it that was lost both by theft and mechanically. The floor of the cell-room was coated with a layer of slime three to five inches thick assaying 30% silver and 5% gold. The clean-up was as follows: Circulation and power were shut off and the lower cells in the cascade were siphoned off to within three or four inches from the top of the settled slime. A workman, wearing rubber boots and gloves, got into the cells and shoveled the 'soup' into a bucket. The bucket was then carried to a screen-covered filter-box, which stood over the cells, and was emptied onto this screen (the rubber boots and gloves worn by the workman cost in Russia, in 1918, 500 rubles, equal at pre-war exchange, to \$250). This screen, made of copper, was of 10 to 12-mesh and only took out the largest lumps of copper and anode metal. The proportion of copper left in the slime after screening was approximately 40%. This filter-box had a capacity of from ten to twelve cells and when the slime from these was screened into it and the solution filtered through the bottom, the box was carried to the door of the leaching-room and the filtered slime shoveled into a bucket, carried into the leaching-room, and emptied into a washing-tank provided with a filter-bottom. This tank was supposed to be kept covered with a 20-mesh copper screen, but this usually was not done. After washing out the

copper sulphate with cold water, the slime was allowed to settle over-night and the next morning it was transferred to a lead-lined leaching-vat. This vat was rectangular, 3 ft. long, 2 ft. wide, and 3 ft. deep, fitted with a steam-agitator (no cone). When this vat was three-quarters full, which usually took three to four days, a weak solution of sulphuric acid was added to the charge and agitated 12 hours by steam. Then the solution, containing mostly copper sulphate, was taken off by a siphon, three washes by filtration were made, and the slime allowed to settle. It was then removed by shovel and buckets, carried to a wood-fired dryer and dried over a slow fire for three days. Then the slime was put into iron-lined boxes, weighed, and sealed with solder. The weight and date was marked on the box and in the record-book. On 16 amperes in the copper cell-room it took 30 to 40 days to get gold and silver from the anode to the dried slime. No inventory was ever made in this plant. The slime was held in stock for a doré furnace-run. Usually 150 poods, or 5400 lb., of dry slime was allowed to accumulate before starting this furnace. The hearth (an inverted arch of magnesite) was 4 ft. wide by 6 ft. long, with a drain slope of 3 inches. The tap-hole was at the front, and the metal was run into cast-iron anode molds, 9 in. wide, 14 in. long, and $\frac{1}{2}$ in. thick. This slime was charged dry and melted down, with sodium carbonate and silica as fluxes, by means of two oil-burners of Russian design. Two bad features were the high-pressure oil-burners used and powdery character of the dry slime. The walls of the dust-chamber 30 ft. from the uptake were shot full of doré metal. Most of the oil burned in the dust-chamber and therefore carried the slime along with the flame and fluxed it into the brick walls. The only correction or improvement that could be made to recover this loss, which amounted to 8 or 10% of value charged, would be by means of a better burner of low-pressure-type and the Cottrell condensation process, which I advised, but owing to the adverse conditions, this was not done. The doré anodes were transferred to the bullion refinery, sampled by the template system, and the silver recovered by the Moebius electrolytic process, using graphite cathodes. Much trouble was encountered in obtaining a cloth suitable for the basket that held the golden mud. Russian cloth at that time was very scarce, so that sometimes we used soldiers' old uniforms, better known as 'rags', which were sewn together to form the basket. The golden mud was cleansed of silver and other impurities by concentrated nitric acid, then melted and cast into bullion bars of 98.84-99.90 fineness. The silver bullion was 99.95 fine. The proportion of metal loss in the bullion refinery for a period of six months was from 2 to 3 $\frac{1}{2}$ %. One of the most difficult problems that I encountered in the handling of the precious metals was theft. During the month of November 1917, I kept an account of the amount of slime that was recovered from anodes in the cell-room and, together with the foremen at the bullion refinery and the cell-room, we estimated the loss to be approximately \$30,000 in the one month. This loss only covered the process from the anode metal to the end of

the cell-room; the loss from the beginning of treatment of slime to the finished doré metal was not obtainable, as no inventory had ever been made. These, of course, were extraordinary conditions; the manager himself frankly stated and realized that nothing could be done. It was the beginning of freedom for the Bolsheviks and the ultimate result of the application of the system of government that defines freedom as the privilege of the individual to do whatever he wishes regardless of how it affects his next-door neighbor. I have watched the operation in the cell-room through the skylight, unnoticed by the Russian workmen, in the hours from 1 a.m. to 3 a.m. and ascertained that most of their time was spent in lifting anodes from the cells and scraping the slime into gunny-sacks. They would then carry these sacks of slime back of the refinery building, dry the slime over a crude fire, divide each man's portion, and the next morning walk out each with his share of the night's work.

One evening, about 11 o'clock, a one-horse wagon left the gate-way of the plant loaded down with what appeared to be two standard boxes of leached and dried slime, worth \$10,000. The watchman at the gate stopped the wagon and inquired of the driver what he had in the boxes. The answer was an order to step aside, backed up by a gun. From November 5, 1917, to the time I left, January 25, 1918, the manager of the refinery was not allowed inside the gates, in fact, he took up his quarters 90 miles away at Ekaterinburg. One other thing that I failed to mention, which connects with the operation of the refining-furnace, was the accumulation of side scrap-copper on the cell-walls in the tank-house. This scrap contained \$20 per ton in gold and silver and was charged into the wire-bar furnace—a bad mistake. The lead used in the lining of the electrolytic cell was soft. They informed me they were unable to obtain antimonial lead for this purpose. This soft lead and the inattention of the Russian workmen, together with the pine-wood used in the construction of the cells, caused many leaks of solution and consequent short-circuits, which in turn caused this deposit on the side walls. The cellar of the tank-house was in poor condition. They did not have lead protecting-caps over the glass insulators and the constant dripping of solution had rotted the supporting timbers. In addition, the brick floor had not been coated with asphalt and the solution had percolated to a depth of 6 or 8 ft. below the floor-level. In this connection, and in connection with the loss of slime in the entire plant, the technical commission of the Kyshtim branch of the Union of Technical Organizations of the Ural made an investigation from December 12 to 13, 1917, on the possibility of reducing the loss of slime. The Commission consisted of engineers of the Kyshtim company. Their translated report follows:

"Having discussed the question and inspected the premises the Commission decided that it was indispensable first to carry out the following measures:

1. To establish an accounting of the production.
2. To establish mechanical cleaning of the tanks of slime.

3. To arrange for the illumination of the tank-room cellar independent of existing lighting arrangements.

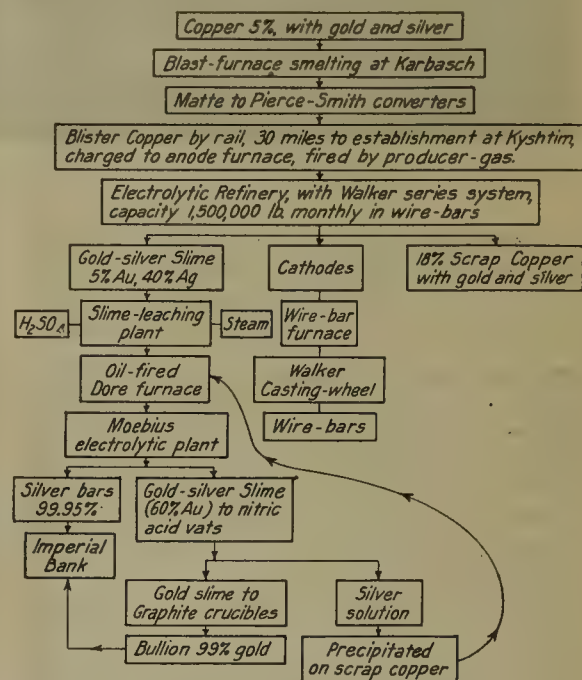
4. The space under the tanks must be kept closed, and opened for cleaning and inspection, only in the presence of responsible persons, and must be well-lighted.

5. The windows of the tank-house and the slime-room must be equipped on the outside with special grating.

6. Incineration of rubbish from the tank-house must be carried on either in the furnaces used for smelting slime, or in other furnaces in the slime-room.

7. It is essential to place in the tank-house technical foremen for three shifts, at present not existing.

8. The number of laborers working in the tank-house must be reduced to a minimum.



FLOW-SHEET SHOWING TREATMENT OF ORE FROM KARBASCH

9. The store-room and laboratory must be provided with an entrance not through the tank-house.

10. The accumulation of slime from under the tanks must be stored in the slime department.

11. The space under the tanks should be excavated half again as deep, to a depth of one *arshin* (28 inches) and lined with asphalt.

12. Drying of slime to be done by steam.

13. To construct dressing-rooms for workers in the slime department.

14. Doors in the slime-room should be kept closed.

15. Doors of bullion store-room should be equipped with electric signals.

Also the Commission considers it of the utmost importance to compel workmen in the tank-house to change their clothes. The Commission, considering many of the above-mentioned recommendations to be of an elementary



KYSHTIM, IN

character, cannot but express its astonishment that they have not heretofore been put into effect."

Signed: B. Pentgov, M. Naumob,
E. Richter, A. Ivoilov.

The Commission caused assays to be made of the soil on the floor under the tanks. Results: Soil taken from the neighborhood of the drain-pipes—gold 0.995%; silver 8.79%; soil taken near the entrance to the space under the tanks—gold 0.034% and silver 3.2%. Analysis of the rubbish heaped around the furnaces for burning rubbish in the courtyard—gold 0.047%, and silver 0.39%; gold 0.084%, and silver 0.65%.

This report covers in general the points to which I had referred in my report of September 1, 1917, but it was impossible for any one to attempt any changes, especially in the labor organization. In my final report I strongly advised shipping the converter copper to England and electrolyzing it in a country where law and order was well established.

The normal production of cathode copper in the Kyshtim cell-room for one month was about 1,500,000 lb. This was melted in a small reverberatory furnace with a hearth 20 ft. long by 10 ft. wide, gas-fired with regenerative chambers—the only copper-refining furnace of this type that I know of. The metal was cast on a Walker machine, the usual product being wire-bar of 125 lb. At the time that I was in Russia the copper produced was stored, as the price on the Russian market was below the cost of production at Kyshtim. Most of the copper used by the Russian industry was brought in from the United States.

On November 5, 1917, the Bolsheviks confiscated all foreign property and capital in Russia and endeavored to operate the plants under Soviet direction. At Kyshtim the manager of the old company was allowed to

supervise operations, but under the direct control of the Council of Workmen. The manager was not allowed to draw any money, to make any payments, or issue any orders without the consent or signature of this Soviet; in fact, the only way in which I obtained traveling expenses from Kyshtim to Petrograd was through a trick of the manager's, and this account had to be charged to general expenses at the plant, the Soviet not knowing of the intended use of this money. They arrested all the engineers, and we were under guard night and day. We were not supposed to make any attempt to leave the property or in any way to hinder operations, but to work the same as we had been doing under the company's orders. The obtaining of Bolshevik permission to purchase passage at the railroad office from Kyshtim to Petrograd was quite a complicated affair. I obtained a ticket through an English auditor who was leaving for Petrograd at this time. He had a round-trip permit from the Bolsheviks between Petrograd and Kyshtim and by showing this permit to the clerk at the ticket-office for his passage, and the next afternoon to the station agent, when the clerk was not around, he obtained my passage and we left Kyshtim on Sunday, January 25, 1918. We arrived at Ekaterinburg at 7 o'clock, the same day, and tried to obtain information concerning the through express to Petrograd, but no such information was available and the only thing we could do was to wait at the depot and trust to luck to pick out the right train and force our way into a car. No tickets were sold and the accommodations were gained only by main strength and push. About 9 o'clock that evening we found that our train had arrived in the yard and with our baggage in our hands we endeavored to get on board. By the time we reached the train it was nearly full of peasants and soldiers, and all compartments were locked. We were not able to get into any of these compartments and the



SIBERIA

Kyshtim Refinery

first 24 hours from Ekaterinburg was spent in the aisle standing with the rest of the 'comrades'. The second morning out, an Australian geologist came out of one of the compartments near the place where we were standing, and we slipped into it. There were ten people in this small room, and they were very much afraid of being put out by the soldiers and peasants. Every half-hour or so some one would knock on the door and demand admittance to see whether we had any standing or sitting room. Unless actual force was used each time the door was opened, one or more of these investigators forced his way in. By the time we reached Petrograd there were 27 people in the compartment, which in normal times had accommodations for only four travelers. This crowd consisted of three Russian women, an Austrian geologist, a Finnish dentist from Omsk, an English auditor, and myself; the remainder being sailors, soldiers, and peasants. The only food obtainable during this five day's trip was that which we carried with us. We were not able to get out of the train, because the minute the door was open, we were very likely to lose our seats. We arrived at Petrograd on January 30. The day before there had been a massacre of Russian peasants by the Bolshevik guard. These peasants in some way had antagonized the Red Guards and the guards turned machine-guns on them in front of the Nicholai station, the result being that the next morning the square in front was piled six or eight feet high with dead bodies; in fact, all through the city a common sight was the arm or leg of a human being sticking out from the dirty snow. Horse-feed at that time was also very scarce and many of the cab-horses would drop on the streets, to be pulled to one side and be covered with snow and dirt. It is no wonder that in the spring of 1918 an epidemic of typhoid and other diseases broke out to such an extent in Petrograd. Most of my time in Petrograd was spent in obtaining a Bolshevik *visé* for my passport. This took two weeks.

An ordinary meal, which consisted of a soup and meat order, with coffee and no sugar, without bread and butter, and no potatoes, cost in pre-war currency about \$75. A cake of Hershey's milk-chocolate, which ordinarily sold for 5c. in this country, was worth three rubles and a half, which in our money is \$1.75. Candy was plentiful, but no sugar was to be seen. I was living with an American engineer who had married into a Russian family and had been in Russia for six or seven years; he had two small children; and in order to obtain milk for them, it was necessary for him to go out into the country at the edge of Petrograd, three times a week. This milk cost 25½ rubles (\$12.50) per quart. If one wished to have bread with a meal in a restaurant, it was necessary to buy bread from the Red Guard on the street and carry it to the restaurant. One had to be very careful about being on the street at night, and I can vouch for an incident that happened to an Englishman while I was there. He was on his way home one evening about 11 o'clock and it was necessary that he take one of the dark side-streets. He was wearing an expensive fur coat and before he reached his destination he was held up by two Russian soldiers, or, at least, they wore the uniform of the Russian Red Guard. They demanded his overcoat and one of them put it on over his own coat. The other one then demanded the Englishman's watch and pocket-book. It was about 30° below zero and the Britisher requested that they give him one of their soldier's overcoats, lest he should freeze before reaching home. The soldier who had taken his watch and pocket-book gave him his coat and he went on his way. On arrival home he felt in his pockets involuntarily for his keys and found his watch and pocket-book, which was typical of the childish actions of the Russian in these days of absolute freedom. The Bolshevik had gone to great pains and possibly waited for two or three hours in the cold to hold up somebody, and then, when he had the money and

watch, he forgot them, and gave them back inadvertently to the man from whom they had been stolen. This characterizes the entire Russian Bolshevik movement from start to finish, so that, if it were not for the murder, hunger, and suffering that they cause, the whole thing would be a huge comedy.

The question of Russian paper currency was peculiar indeed. Kerensky had issued a war-time paper currency and the amount of this paper used was increasing every day, so that by the time that the Bolsheviks obtained power there was not enough money. The printing presses were flooded with work. Along with this condition there arose a set of counterfeiters who had a peculiar method of putting their money on the market. They used the same dies and paper that the Government used and issued the same note, with the exception that they printed across the face of each note this statement: "Ours is just as good as yours," and this money was accepted and passed at the same value as the Kerensky issue—a story that is hardly believable and yet goes well with the chaotic conditions of the country. It was impossible to purchase anything with Russian gold or silver, as all this was supposed to be turned in to the Government, and anyone who had gold and silver in his possession was liable to arrest and imprisonment by the Bolsheviks. I remember that I carried 90 rubles in gold in the waist-band of my trousers from Kyshtim to Stockholm. At this time German spies were buying up all the old Russian currency, and money was being made by people in Petrograd by playing the German-Russian exchange market. In the shopping district of Petrograd, it was rare to see any display windows that had a full plate-glass front and all the foreign shops were boarded up to protect the glass from destruction. In walking along the streets, you would notice a large plate-glass window with half a dozen small holes, pasted over with some sort of paper; upon investigating this paper, you found the signature and date of the man who had childishly chosen this as a mark to shoot at.

On February 15, 1918, I obtained my passport from the Bolshevik government and left Petrograd on the Finnish railroad for Helsingfors. I assure you that it was quite a relief to travel on a railway under normal conditions, and with a certain amount of safety. There were no dining-cars on this railway, but one thing that appealed very much to me was the method of serving meals in the restaurant at the station. Upon entering the restaurant, we were given a ticket; the food was obtainable from long tables arranged in what we call 'cafeteria' style; and it was abundant and varied. You helped yourself to all you wished and each paid the same upon leaving. A good meal cost not over \$1. You may be sure that I enjoyed this arrangement after the food-shortage in Russia. Note that this was only 160 miles from Petrograd.

Upon arrival at Helsingfors, Finland, we found that the railway to Stockholm by way of Torno had been destroyed by the Red and White war, which at that time was at its height in Finland. We were advised by the

British consul to get in touch with a British naval captain who was taking an old army transport from Abo to England, by way of Stockholm. We found that the captain had already accommodated 600 refugees, consisting of citizens of Sweden, Finland, Russia, Austria, Germany, France, England, and the United States. He was glad to help us out and assured us that he would try to land us at Stockholm 48 hours after leaving Abo. It was necessary that we take our own food to last us this 48 hours. This we did, and left Abo on Sunday, February 17. The transport had a poor engine and only half a propeller; for this reason we were towed through the thick ice by a Russian ice-breaker. The ice extended about three-quarters of the way to Stockholm, where open water was encountered. Twelve hours out from Abo the Russian crew on the ice-breaker struck for more money, and since we failed to meet their demand, they left us frozen in the ice among the Alland islands. We were here two weeks, and as our food supply was intended only for 48 hours, it was necessary that we make daily expeditions to the little villages on the islands in order to feed 600 people. At last we made arrangements with another ice-breaker to tow us to Marienham island. They were only able to get us to an isolated part of the island and from here we had to sleigh across to the main port and were taken on board a Swedish vessel that landed us at Stockholm on March 4—two weeks and a half after leaving Abo. We found that the next vessel for New York left Christiania on April 11, five weeks later, so we had plenty of time to see Norway and Sweden.

We sailed on the 'Bergensford' from Christiania, Norway, and after a 20-day voyage, which was necessary in dodging submarines and mines, we landed at New York on May 2, 1918.

ROCK SPECIMENS are continually being sent to the U. S. Geological Survey with the request that they be 'analyzed' or 'assayed'. The question is frequently asked "What is the difference between an assay, an analysis, and an expert examination of a specimen of rock or mineral?"—such a specimen as may be sent to the Survey by anyone who has found or thinks he has found a valuable mineral? Ninety-nine out of every hundred specimens submitted to the Geological Survey are found upon inspection to be commercially valueless. Such an inspection or test, however, is widely different from an analysis. A complete analysis of a rock that is composed of many different minerals may require from two to six weeks' time in the laboratory, involving the more or less continual attention of a chemist equivalent to three or four days of his time, and such work is done by the Survey only in connection with its own scientific investigations. An assay, on the other hand, is usually a fire-test made to determine the exact metal content of an ore specimen. The Geological Survey makes no assays for private parties, but does make inspections or simple chemical test and reports the findings to the persons interested.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

CO-OPERATIVE SCHEME OF MINING OREBODIES AT CLIFTON.

BISBEE.—An announcement has been made by Norman Carmichael, general manager for the Arizona Copper Co. and P. G. Beckett, general manager for the Phelps Dodge Corporation, that a joint investigation is to be undertaken at once in the Clifton-Morenci district with a view to determining whether better and more efficient results can be obtained by a plan of joint extraction of the large low-grade orebodies which lie partly in the territory of each company. Under the present existing conditions and method of operations it is conceded that these ores cannot be mined separately to the best advantage, and it is with a view to combined operations that the investigation is to be made.

COURTLAND.—The Leadville Mining Co., at Courtland, which has been working 20 men and shipping ore, has ceased operations pending the return of normal conditions on the railroads. Some lessees on the property are continuing work.

KINGMAN.—The bullion shipments of the United Eastern Mining Co., at Oatman, amounted to \$561,759 for the first quarter. The annual meeting was held at Oatman in March, when the old board of directors were unanimously re-elected. The report of the president stated that \$2,031,594 was the gross value of the ore mined and milled in 1919. The total tonnage put through the mill was 97,325. The ore-reserves as of January 1, 1920, were 269,207 tons of ore having a gross value of \$6,000,820. This is an increase in tonnage over 1919, but a decrease of over \$400,000 in gross value. The present mill-tonnage is about 325 tons per day.

NOGALES.—By a recent verdict in the Superior Court of Santa Cruz county, Frank Powers recovers the half-interest in the World's Fair mine which he agreed to transfer to A. A. Holland if a mill of 100 tons daily capacity was constructed on the property. Holland assigned his interests to James Emery and the late Hiram Whitcomb. Powers contended that the mill was not suitable and did not have the required capacity and asked for cancellation of the contract. A 3½-ft. vein of lead-silver ore has been opened in the old National mine, formerly owned by George Gross, which was taken over the first of the year by the Gold Star Mining Co. The mine is situated in the Patagonia range 14 miles from Nogales. Ten men are at present working at the mine.

Jim Layman, who has spent \$80,000 in development at the Blue Nose mine, has organized the Arizona Pata-

gonia Silver Mining Co. with \$500,000 capital to acquire the property and continue development and erect a 100-ton mill to treat the old dump-ore as well as the ore opened up by the recent development on the 160-ft. level. The 9000 tons of ore in the dump is said to average 23 oz. silver, 1% copper, and 1% lead. Recent treatment-tests have been made on the ore and show that it can be worked at a profit.

TOMBSTONE.—W. T. Boyd and associates, who recently purchased the Solstice mine known as the old Winters mine, will commence development work within a few days. This work will be in charge of E. K. Springer. Work is to be done in the old drift where the late owner for the past several years took out a large tonnage of high-grade silver ore. The dump has been leased to the Giacoma brothers.

WICKENBURG.—W. H. Worthington and Grover Hubbel of Wickenburg, who have purchased the Monte Cristo mine, have cleaned out the old workings above the 100-ft. level and have exposed \$100,000 worth of silver ore. The old shaft is down 400 ft. and a large amount of work has been done above the 300-ft. level. A K & K flotation unit has recently been set up and is working with success. A cleaner and second unit will increase the mill-capacity to 40 tons per day and improve the extraction.

WINKELMAN.—The Continental Commission Co. that recently secured a bond and lease from the heirs of Mike O'Brian on the old '79' mine, four miles from Burns station, on the Arizona Eastern railroad, is now developing the mine. Since commencing operations the company has shipped to El Paso seven cars of ore and has eight cars on the way. The ore that is being shipped averages 25% lead, contains a small amount of silver, and occurs chiefly as carbonate in veins in limestone. The orebody is now opened up along the vein for 200 ft. and to a depth of 150 ft. A road to the mine is to be built and machinery erected at the earliest possible moment. On the other claims of the property there are attractive outcrops of wulfenite, vanadium, and descloizite.

Development at the Antelope Peak Mining Co. in the Tortilla mountains 12 miles from Winkelman is progressing. This property was worked for silver 40 years ago. The vein is seven feet wide, all of which is said to be milling-ore. One to four feet of the vein can be mined and shipped direct. The shaft has reached a depth of 440 ft. and development has been done on six levels above the present lowest level. This work has shown the orebody to have an average length of 200 ft. and has yielded

1000 tons of shipping ore. Stopping operations have just commenced, and the shipping ore averages 12% copper.

COLORADO

VINDICATOR CONSOLIDATED OBTAINS LEASES.

LEADVILLE.—Shipments to Chicago of manganese ore from the Leadville mines have been temporarily suspended because of freight congestion in the railroad yards in the Illinois city. The management of the Star continues hoisting and is now storing ore. The A. V. mine, at the foot of Harrison avenue, continues hoisting manganese ore and will resume shipments when the situation is relieved. Plans are under way to resume at the Jason shaft in the Poverty Flats section where a good grade of manganese ore is found. The Leadville Leasing company has purchased a 50-hp. hoisting engine and other equipment for the O'Donovan Rossa mine and development will commence as soon as the machinery is in place. The O'Donovan Rossa has been inactive for years, but rich orebodies are expected to be opened at greater depth. The annual meeting of the Yak Mining, Milling & Tunnel Co. for the election of directors will be held at the office of the company in Denver, on May 18.

CRIPPLE CREEK.—Development by the Vindicator Consolidated company during the first quarter of 1920 was somewhat disappointing in its results, according to information contained in a circular letter mailed stockholders under date of April 25, and it is further announced that the directors "after thoroughly canvassing the whole situation, unanimously decided that it was inadvisable to make any disbursement to the stockholders at this time". The quarterly dividend therefore has been passed. The ore-shoot on the 19th level of the Vindicator was proved for 300 ft. on the Lillie vein, and continued to a height of 70 ft. above the level. Drifting on the 20th level has disclosed ore of excellent grade, but "payable values exist apparently for a length of only 60 feet". Development is continuing on this and four other levels in this virgin section, but none have yet reached the extension of the ore-shoot. Announcement is further made that a five-year lease has been secured on the Victor mine property and five-year leases on all the various groups lying between the Vindicator and the Victor mine, and on the Arvilla group west of the Victor. The royalties are reported to be reasonable and options to purchase a portion of the territory have been secured. The Victor shaft is 1000 ft. deep and is about 3000 ft. north-east of the Vindicator main shaft. Intervening territory will be intersected by a cross-cut from the Vindicator shaft and the several known veins that are thought to traverse this ground will be explored by drifts. Sub-lessees in the old workings of the Victor are reported to be already taking out a good grade of ore. The Vindicator company has two other development propositions, one in the Cripple Creek district and the other in the San Juan section of the State on which work will be started in May.

The Hoosier mine on Tenderfoot hill, formerly owned

by the Grafton Gold Mining Co. has been sold to J. W. Downer and associates, of Colorado Springs, who have taken possession and will, it is announced, start operations shortly. The Hoosier mine is accredited with production by lessees of about \$500,000. The Grafton company was at one time on a dividend-paying basis and paid \$10,000 in October 1899. The deal was made through D. J. Rubridge of Denver, vice-president and treasurer of the Grafton company, since its incorporation in 1896. The consideration has not been made public, but it is understood the deal was for cash.

IDAHO

A CENTRIFUGAL 'GOLD-SAVING' MACHINE.

CLARK'S FORK.—The Clarinda Copper Co. has increased its area to 166 acres and is putting in equipment. It will drive tunnel No. 4 from the base of Howes mountain on the transcontinental highway. The Clarinda property and the Carpey mine at Cabinet were inspected recently by Charles J. Ashbaugh, Martin R. Gunzel, J. P. Delaney, and William Thompson of New York.

ROCKY BAR.—Recently the American Mining & Development Co., of Spokane, obtained possession of the Independence, North Star, and other claims west of town, and between the famous Elmore and Pittsburg properties on the south and the Ghost and Lansome on the north. The company also purchased the old Reeser mill-site and all of the natural flow of water from Bear and Steel creeks.

MURRAY.—The mine of the Giant Ledge company, four miles from Murray, consists of 65 claims, covered with timber sufficient for all needs. A vertical shaft 400 ft. deep, with a cross-cut 120 ft. to the vein, and drifts 750 ft. north and 450 ft. south, are all in ore, assaying from \$8 to \$97 per ton in gold, silver, lead, and copper. Power is furnished by a 22-hp. steam engine or a Pelton water-wheel. The mine is well equipped with a seven-drill air-compressor of Ingersoll-Rand manufacture. A 112-hp. hoist and pumps are run by electricity.

BONNERS FERRY.—Twenty-four miles north-east of here is the Buckhorn mine owned by the Cyanide Gold Co. Five full claims are traversed by two parallel veins about 6 ft. wide. The ore is gold and silver. A 50-ton ball-mill with air-compressor and gasoline engine will be installed in May. The company is using the new gold-saving machine of the Redemption Gold Co., of Spokane. The principle is that of centrifugal force. A quantity of mercury is contained in a bowl and this is rotated at high speed, until the mercury gradually mounts up and forms a thin film around the sides of the bowl. The ore, ground to 100-mesh, is fed into the bowl, reaches the bottom, and it, too, spreads around, working its way up along the whirling mercury film, the particles of gold having a tendency, because of the intense centrifugal force, to edge outwardly through the lighter material and being also of greater specific gravity than the mercury, work into it, while the tailing, having a less specific gravity, climbs up over the rim of the bowl and is forced out through a tube.

BUTTE.—The strike situation in Butte has improved considerably. Since the arrival of 300 United States troops, there have been no disturbances either in the city or on roads leading to the mines. There has been a substantial increase in the number of miners reporting for work, but operating conditions are far from normal. Little or no ore is being hoisted. The available labor is being used on shaft-repairs and general plant clean-up. It is estimated that close to 3000 men have left town since the strike's inception.

NEVADA

THE TONOPAH DIVIDE REPORT.

DIVIDE.—The annual report of the Tonopah Divide states in the most important paragraph: "By assuming that the areas exposed on the different levels are representative of the orebodies and making nominal allowance for continuation beyond faces which expose a block only on one side and allowing a normal admixture of waste-rock in mining, the developed and probable first-class ore at this time is 52,000 tons averaging 20 oz. silver and 0.08 oz. gold, containing a total of 1,040,000 oz. silver and 4160 oz. gold. The gross value, at \$1.25 for silver, will be approximately \$1,385,000." This part of the report is signed by E. A. Julian as consulting engineer. H. C. Brougher, president, in his report, says: "Last year's report contained a speculation by A. I. D'Arcy, then consulting engineer for the company, on the amount which would be available in case subsequent work should prove the ore continuous between the different exposures then made. Unfortunately this statement was deliberately misquoted by many to be an estimate of ore then developed and the incorrect statement was given wide publicity." Mr. D'Arcy said in his report: "The mine has not been sufficiently developed to measure the ore-reserves, but as a matter of speculation the openings now existing in the mine, if taken to represent the true average over a width of $21\frac{1}{2}$ ft., a length of over 400 ft., and a depth of 500 ft., would produce 330,000 tons of ore, and if the value as indicated by sampling is taken as \$27.60 per ton, the mine could be expected to produce \$9,108,000 gross." The difference in the reports of the two engineers and the president's explanation, particularly the latter, are regarded as remarkable. While the statement of Mr. D'Arcy may have been 'deliberately misquoted' and while it was a 'speculation', the cutting of this 'speculation' by nearly \$8,000,000 presents a rather peculiar situation, in the opinion of persons interested in the mine. Mr. D'Arcy's report was known to be a 'speculation', but that it was subject to a variation of \$7,723,000 was not the sense in which the former consulting engineer expected it to be understood. Well informed persons did not take Mr. D'Arcy's report to be an 'estimate of ore then developed', but they did think that it was not to be taken as an indication that months of additional development might show his \$9,108,000 'speculation' to be an over-estimate of \$7,723,000. During 1919 the company shipped to the MacNamara mill in Tonopah 9612 tons of ore which was treated with a net recovery of \$254,950. The operating costs were \$194,409, leaving a net realization of \$60,541. A total of 7578 ft. of development work was performed to December 31, 1919. The 'gold' vein was cut on the 370-ft. level, but it only "crossed several seams which showed uncommercial values. A drift has been extended 40 ft. on the best looking seam, but with negative results".

FAIRVIEW.—The Broken Hills Silver corporation, newly organized, has taken over the Broken Hills group of seven claims, 15 miles south-east of Fairview. The claims have been developed through a 150-ft. shaft by J. M.

Stratford and J. H. Arthur, who located them in 1913. Lateral work has been done at 50, 100, and 150 ft. There are three other shafts and the vein, of an average width of 4 to 5 ft., has been opened for a distance of 550 ft. The vein is on the hanging wall of a mass of andesite more than 75 ft. wide, which has never been cross-cut, and engineers think the foot-wall side offers great possibilities. Stratford and Arthur have shipped through Fallon, 70 miles distant, 400 tons of ore of an average value of more than \$100, a sorted product. The average width of the vein on the 150-ft. level is 8 ft. and the average metallic content is 18.51 oz. silver and 0.06 oz. gold. The value of the ore exposed in all workings is estimated to be \$175,000.

COPPER BASIN.—Lumber for additional buildings is being hauled from Battle Mountain to the Buckingham and it is planned to work from 25 to 30 men during the summer. The shaft is to be sunk to 500 ft. from the present depth of 200 and the Northland and Midland drift tunnels are to be extended. A new hoist and an air-compressor will be erected. There is a good tonnage of silver-lead ore exposed and if the work planned produces satisfactory results a treatment-plant will be built. Some of the ore is rich and at two places in drifts from the shaft 5 ft. assaying \$150 in silver, gold, and lead is exposed. The ore contains 200 oz. silver to one of gold, with a lead content varying from 5 to 10%.

GOLD CIRCLE. Supplies are being brought into the district for the resumption of work on the Queen. The main shaft is to be sunk 100 ft. from the present depth of 230. At 130 ft. the shaft entered a fault. Sinking was continued through the fault to 180 ft., where a cross-cut opened ore. Sinking was then resumed and ore was found in the shaft last October, with the vein in better condition than above the fault and assaying \$25 in gold and silver for a width of eight feet. The Elko Prince is developing important ore-shoots on the 600-ft. level of the 950-ft. shaft and the 40-ton cyanide mill operated throughout the winter. The mill was started late in 1915 and since then it has produced nearly \$2,000,000 in bullion. The Big Chief Consolidated is reported to be planning the erection of a cyanide-mill to treat ore from the Missing Link and Jackson claims, where a large amount of work was done during the winter by a crew of 16 men who developed ore of milling grade.

CACTUS.—A cross-cut that has been driven 20 ft. into the vein at a depth of 265 ft. in the Cactus Nevada has exposed 16 ft. of silver ore of an average value of \$15. The vein is from 75 to 100 ft. wide, with the best ore occurring on the walls. The important feature of the work at this depth is that the vein is in much better condition than on the 116-ft. level. Sinking of the shaft from 265 ft. has been started and another cross-cut will be driven at the 365-ft. point.

TONOPAH.—The labor situation in Tonopah and Divide is nearly normal. The mine operators and merchants have declared war on the I. W. W. element, which is held responsible for the two recent strikes.

NEW MEXICO
CHINO COPPER CO.

HURLEY.—During 1919 the Chino Copper Co. drilled two development holes with a combined depth of 924 ft., which brings the total footage of such work up to 265,672. Since the beginning of operations, the mine at Santa Rita has produced a total of 19,746,650 tons of ore, averaging 1.86% copper, and the reserves as of January 1, 1920, are estimated at 94,781,525 tons, averaging 1.62% copper. The total quantity of stripping removed from the mine during the year was 3,161,381 cu. yd., bringing the total quantity of stripping removed since the beginning of steam-shovel operations on September 23, 1910,

pared with 0.109c. for 1918. The value of the copper produced during the year was \$7,308,597, and of gold and silver \$17,928, making a total of \$7,326,525. The net income was \$1,301,797, or \$1.50 per share, as compared with \$3,908,222, or \$4.49 per share in 1918. The average price received for copper delivered during 1918 was 18.784c. per pound. Dividend disbursements during 1919 were at the rate of \$3 per share, or \$2,609,940. The grand total of such disbursements to the end of 1919 was \$29,012,982. Metallurgical research has progressed sufficiently during the past year to indicate that the problem of a more profitable treatment of partly oxidized ores on a commercial scale is approaching a satisfactory solution.



THE UNITED STATES SMELTER AT MIDVALE, UTAH

to January 1, 1920, up to 27,025,136 cu. yd. The cost of steam-shovel mining and stripping combined during 1919 was 64.91c. per cubic yard, as compared with 69.55c. for 1918 and 33.97c. for 1915. The mill at Hurley treated 1,765,200 dry tons of ore during the year, as compared with 3,836,400 dry tons for 1918. The average copper content of the ore during 1919 was 1.82%, or about 0.2% higher than for 1918. The production of concentrates was 128,154 dry tons, averaging 16.5% copper. The average cost of milling was \$1.56 per ton, being an increase of 19c. per ton over the previous year. During the year there was shipped direct to the smelter 34 tons of copper precipitate, containing 22,721 lb. of copper. The total production of copper from all sources during 1919 was 42,325,449 lb., as compared with 79,340,372 lb. for 1918. The average cost per pound, excluding charge for Federal income and profits taxes, and without credit for precious metals recovered and miscellaneous income, was 15.53c., as compared with 14.13c. for 1918. Credits for gold and silver and miscellaneous income for 1919 were equivalent to 0.216c. per pound of copper produced, as com-

In August 1919 tailing air-lift equipment was put in operation. This raises the tailing approximately 40 ft., giving the necessary elevation to carry it to the new lower tailing storage by gravity. This scheme, while a departure from ordinary methods of elevating tailing, has demonstrated operating economy and has affected a substantial decrease in the cost of tailing disposal. Throughout the year operations were conducted on approximately 50% basis.

UTAH

CURTALMENT AT EUREKA AND PARK CITY.

BINGHAM.—Recent work at the Victoria mine of the Bingham Mines Co. has been highly gratifying, according to Imer Pett, general manager. A sub-level from a winze sunk below the 1300-ft. level has disclosed over 60 ft. of high-grade ore. It is probable that this ore will be extracted from the adjoining Dalton & Lark workings, and a connection with one of the latter company's drifts is now being made. During January, the net earnings from this property were \$9758; during Febru-

ary, \$17,720; while the March earnings are estimated at \$20,000.

PARK CITY.—The district suffered more than any other in the State as a result of the strike of railroad switchmen, not a car of ore being shipped during the week ending April 24. As a result the mines here have accumulated approximately 2000 tons of ore which normally would have been shipped during the week. This is the first time since the strike of miners in June 1919 that no shipments were made from the district. Paul Hunt, superintendent of the Park-Utah property, reports conditions improving in the mine. A small vein of first-class ore is being followed, which it is expected will develop into a commercial body before long. A considerable tonnage of low-grade ore has been developed, with frequent seams running high in silver and lead. The new pump at the Iowa Copper mine is working satisfactorily, and progress is being made in dewatering the shaft and drift on the 200-ft. level. It is expected that mining operations will be resumed in the face of the drift early in May.

A contract has been awarded to the Diamond Drilling Co. of San Francisco for extensive drilling at the property of the Three Kings Consolidated Mining Co., according to P. J. Mackintosh, general manager. It is the intention of the management to continue exploration work by this method, and to locate definitely the Weber quartzite contact from the bottom of the winze on No. 4 fissure. This fissure was intersected by the main cross-cut on the 200-ft. level, a distance of approximately 1000 ft. from the main shaft. The management has decided that it is necessary to explore this contact as quickly and thoroughly as possible.

EUREKA.—While mines in this district were supplied with some cars during the week ending April 24, not enough were furnished to handle more than one-third of the regular weekly production of the district. The Salt Lake & Los Angeles railroad, which handles most of the ore from this camp, was unable to supply a single car, and the mines had only the cars for loading that were furnished by the Denver & Rio Grande railroad. Mines in the south end of the district were unable to secure cars. As a result the men employed in the Mammoth and adjoining properties were taken from ore production and put on development, where they will be employed until the railroad situation is cleared up. The Chief Consolidated was handicapped by the car-shortage and compelled to lay off some of its men.

No work is being performed on company account at the property of the Colorado Consolidated, all of the levels now being turned over to lessees. The work which the Knight interests were doing for the benefit of the Sioux and Empire mines, operating from one of the lower levels of the Iron Blossom, has been discontinued for the present. However, the work being performed in the Empire mine through the Lower Mammoth shaft has not been interfered with. E. R. Higgensen, who several months ago secured a lease on the old Sunbeam mine and has been actively working it during the meantime, mined

fifty cars of ore, all but five of which have been sent to the Tintic mill. Mr. Higgensen states that up to the present, all ore has been taken from workings above the 300-ft. level, but in the near future operations will be started on the 350-ft. level, where there are indications of ore. Owing to the large amount of work required to re-timber the old shaft and clear the workings, mining has not progressed as rapidly as was expected, but within a week, the shaft should be re-timbered to the 350-ft. level.

The new shaft at the property of the East Tintic Coalition is now at the 200-ft. level. Slow progress has been made of late, owing to the fact that but one shift has been employed.

The Griggs Huish Leasing Co. has closed a deal for a four-year lease on the milling plant of the Godiva Mining Co., which it proposes to remodel and put into running order with as little delay as possible. At the time this company was launched, it was generally understood they would take a lease on the May Day mill, but plans were changed owing to the Godiva mill being much larger and already containing most of the machinery that will be needed. New crushers and vanners have already been ordered, and C. C. Griggs, manager, is confident that the plant will be in running order within six weeks. A contract for the erection of ore and concentrate bins has been let to Alex Mattson. Officers of the Griggs Huish Co. are: C. C. Griggs, president and manager; J. Fred Johnson, vice-president; C. E. Huish, treasurer; George T. Castleton, secretary.

ALTA.—Operations at the Logger mine in Big Cottonwood canyon, suspended during the past few weeks owing to severe weather, have been resumed, according to R. D. Maxfield, president. Recent sampling in the face of ore in the south drift showed 0.06 oz. gold, 2.7 oz. silver per ton, and 31% copper. The mine never was in better condition than at the present time, according to Mr. Maxfield. Service over the Utah Power & Light Co.'s line from Big Cottonwood canyon to the Emma mine was resumed on April 27. Since this line was taken out by the big snowslide, the Emma property has been getting power over the Wasatch Mines' line. This was only enough to keep the water in the Emma shaft below the 200-ft. level. Now the normal power service has been resumed, the shaft can be speedily unwatered.

BRITISH COLUMBIA

THE 'ONE BIG UNION' IS ACTIVE.

NELSON.—The 'One Big Union' is again fomenting trouble among the miners, and, at the time of writing, it looks as though work at most of the large mines in the Kootenay will be discontinued. The union demands an increase of \$1 per day in the pay of both miners and laborers, the present schedule being \$5.50 for miners and \$5 for laborers, and that the companies shall provide white sheets and pillow-cases at their boarding houses. At a meeting of mine-owners at New Denver, it was decided to deny the union's demand, and already the miners at three mines near New Denver have been called out. Other districts are likely to be affected in which

event a considerable reduction in production will result. Recently the Consolidated Mining & Smelting Co., that is operating a number of mines in the Kootenay district, raised the pay of all its employees 50 cents per shift, and on April 15 it put into force a scheme of life insurance by which the employees who have been in the service of the company for six months are insured with the Sun Life Assurance Company of Canada for \$500. This sum will be increased \$100 for each six months service until it reaches a maximum of \$1500. It is an open secret that labor trouble that was known to be brewing was the cause for the cessation of work on the 1500-ton concentrating plant that is to be erected at Trail for treating the ores from the Consolidated company's Rossland mines. The ground had been broken and the cement and steel had

gineer, discussing conditions in northern British Columbia, says that, although there is much excitement over mining prospects in this section and notwithstanding that this sentiment appears to be justified to some extent, there are as yet only three proved mines of note. These were the Dolly Varden at Alice Arm, the Engineer in the Atlin district, and the Premier of Salmon Arm. But these are great properties. He continues: "The Engineer, at Carcross, is a proved gold mine and will operate this year if the will of the late Captain Alexander, who was the owner, is executed. Shipments from this mine would be made by water to the White Pass railroad where ore would be taken by rail to Skagway and thence south to the smelters. This mine will have the same effect in making Atlin an active town as the Premier and the



MILL AND OFFICE BUILDINGS OF THE NACOZARI CON. COPPER CO., SONORA, MEXICO

been ordered, when the threatened labor trouble stopped further operations.

SLOCAN.—Three lessees, who are operating the Utica mine, have struck rich ore about 500 ft. from the mouth of the tunnel. The vein is $5\frac{1}{2}$ ft. wide and from eight to ten inches on the foot-wall is heavily impregnated with wire and plate-silver, which carries some gold. The remainder of the vein is a dense mixture of gray copper and galena, with the gray copper predominating. During the year that these three miners have had the property, they have netted nearly \$75,000, and it looks as though they would add another \$25,000 to that sum before the expiration of their lease, on June 1. Two feet of galena is reported to have been struck at the Silver Bear property, on Kaslo creek. W. E. Newton, who is managing the Silver Bell for the Green brothers, is starting operations with 12 men. The force will be increased to double that number as soon as suitable men can be found.

STEWART.—George Clothier, Government mining en-

gineer, discussing conditions in northern British Columbia, says that, although there is much excitement over mining prospects in this section and notwithstanding that this sentiment appears to be justified to some extent, there are as yet only three proved mines of note. These were the Dolly Varden at Alice Arm, the Engineer in the Atlin district, and the Premier of Salmon Arm. But these are great properties. He continues: "The Engineer, at Carcross, is a proved gold mine and will operate this year if the will of the late Captain Alexander, who was the owner, is executed. Shipments from this mine would be made by water to the White Pass railroad where ore would be taken by rail to Skagway and thence south to the smelters. This mine will have the same effect in making Atlin an active town as the Premier and the

Dolly Varden have had on Stewart and Alice Arm. In the Stewart and Alice Arm districts there are many properties under development and several of them show great promise. Nothing more, however, can be said of these until more work is done. A mining country cannot be developed in a single year and we will know more about it a year from now. Vancouver and Victoria are full of companies, many of which own properties on which no development work has been done."

SHEEP CREEK.—Harold Lakes, superintendent for the Nugget Gold Mines, Ltd., reports that the old Motherlode mill is ready to commence the season's work as soon as a shipment of cyanide, now on order, arrives. Recently efforts at the mine have been concentrated on the laying of track, the construction of chutes, and otherwise preparing for production. Mr. Lakes reports that the drift on the main vein at a depth of 625 ft. has developed ore for a total distance of nearly 200 ft. Drifts driven both to east and west are still in ore. While the width of the vein varies the grade of ore is maintained.

ONTARIO

RICH ORE AT BOSTON CREEK.

BOSTON CREEK.—Electric power has been turned on at the Miller Independence mine, where the two transformers have a combined capacity of approximately 1000 hp. The central shaft has been completed to the 500-ft. level, where cross-cutting is being done to cut the downward continuation of the rich orebody developed in the inclined shaft. Tests made at Toronto University on samples of rich ore have shown that the telluride which the ore contains in large quantities is of the highest grade, known as 'calaverite'. At the Kennedy-Boston, where the main shaft was put down 100 ft. by hand during the winter, a mining plant is being erected. Sinking will be continued to 150 ft., at which level the main vein will be opened up.

PORCUPINE.—At the Davidson Consolidated the drift on the 500-ft. level has been advanced for 480 ft. from the shaft, the vein showing a width of 40 ft. of ore. Diamond-drilling will be undertaken from the 500-ft. level to explore a new vein, believed to parallel the main lode. The Hayden-Porcupine and Sovereign Porcupine companies are making arrangements to resume work. At the Sovereign property over 4000 ft. of diamond-drilling was done last year and a heavily mineralized vein was discovered and stripped for 45 ft., work being discontinued when the winter set in.

BEAVER HOUSE LAKE.—The Argonaut gold mine has made a shipment of several hundred ounces of bullion to the Ottawa mint. Vein 202 has been opened for over 170 ft. and has yielded a good grade of ore varying in gold content from \$11 to \$23 per ton. Drifting is being undertaken toward a porphyry dike, where diamond-drilling has indicated richer ore at a depth of 250 feet.

COBALT.—The Mining Corporation of Canada is starting its improved plant for the treating of tailing pumped from Cobalt lake. The material from the pumps will be classified over Dorr machines, the slime being cyanided and the sand carried by aerial tram to the plant, which has a capacity of about 450 tons daily. The pumps will handle 1000 tons per day, the surplus being stored for treatment next winter. About 400,000 tons of sand is still to be reclaimed.

At the 425-ft. level of the Chambers-Ferland mine of the Aladdin-Cobalt Co. a vein four inches wide and composed of calcite and smaltite has been opened in which the silver content has been found to vary from \$5 to \$4000 per ton. During March shipments of ore from other parts of the mine were maintained at about 30 tons per day, resulting in a substantial margin of profit, it being officially stated that the ore averaged \$26 per ton.

The Beaver Consolidated has secured a lease on the adjoining Prince property. The deal is the result of the Beaver having followed a four-inch vein up to the boundary of the Prince claim at a depth of 1400 ft. The lease provides an even division of the 'net' profits derived from the operation.

Robert Lyman, manager of the Senece Superior mine

during its brief but profitable career, has secured a lease on the Rochester property, and is concluding plans for exploration by using the shaft on the adjoining Lumsden mine, from which a cross-cut extends onto the Rochester at the 300-ft. level.

It is announced that within the next week or so the McKinley-Darragh will resume work with its oil-flotation plant which was closed in January owing to the difficulty of treating tailing from the bed of Cobalt lake during the winter weather.

MEXICO

MINA MEXICO MILL TO START.

AGUA PRIETA.—Messrs. Hayes, Horkins, and Munoz of the Mina Mexico staff, have arrived here from El Paso, preparatory to operation of the mill on the property, which was expected to start April 30. Placing of the flotation machinery and remodeling of the old concentrator have been completed. It is expected to send out about 150 tons of silver concentrate, or about five carloads, monthly to El Paso. For the present, it is understood, the greater part of the ore passing through the mill will come from the old dumps.

John W. Ammerman and associates, of Kansas City, who are directors of the Sonora Development Co. with valuable properties in the vicinity of Pilaes de Nacozari, visited Agua Prieta recently to investigate conditions. Mr. Ammerman and a geologist from Patagonia, Arizona, visited the properties.

CANANEA.—The rail strike has not seriously affected this camp and according to statement of George Young, secretary-treasurer of the Cananea Consolidated Copper Co., a plentiful supply of all necessities is on hand for the present. Tyndall Evans, general manager for the company, accompanied by Mr. Young and his private secretary, Charles L. Montague, went to Agua Prieta on April 22, holding a conference with General Calles, the nature of which was not made public. According to recent announcement of the American consulate at Nogales, the withdrawal of the garrison from Cananea recently caused the American residents there to apply to the State government for permission to arm themselves and form a civic guard. Soon after the request had been made, however, a new garrison of 50 soldiers arrived to police the camp.

CUMPAS.—H. J. Glennon, manager of the Nacozari branch of the Phelps Dodge Mercantile Co., has taken a lease on the Belon property, situated in the vicinity of Cumpas. He will start development and mining operations soon. Large orebodies have been developed in the property by former operators but in recent years it has lain idle owing to unstable conditions.

LAMPASAS.—J. B. Barney, in charge of the Lampasas mine for several years, reports that the mine is not producing at present, the lack of water making it necessary to close down the mill. Fuel also has to be hauled seven miles over a rough trail. Efforts are being made to overcome these handicaps and operate the mine.



ARIZONA

Tucson.—The Arizona Tonopah Mining & Milling Co., whose property is in the Amole district, nine miles southwest of here, recently found gold, silver, and lead ore in No. 3 shaft and in east and west drifts valued at \$73 per ton. The ore from this shaft from the surface to the 100-ft. level averaged \$27.50 per ton. The three-compartment shaft has reached a depth of 145 ft. George Ankers is general manager.

CALIFORNIA

Amador County.—Bulletins have been posted announcing an increase of 50c. per shift for all days-pay employees of the Plymouth Consolidated Gold Mines, Ltd. The bulletin states that the increase is given in an effort to offset the high cost of living, which the company realizes is abnormal, and it promises that the increase will stand while present conditions continue. The cost of operation has increased \$2 per ton in the last two years, and the men are urged to give their best efforts to increase production. The same increase has gone into effect in all of the mines controlled by W. J. Loring and associates, which include the Morgan at Carson Hill, and the Calaveras at Melones. The new scale makes the wages of the muckers \$4 per day and those of miners \$4.50.

COLORADO

Alma.—The lessees of the Champaign mine will resume operations in May and R. H. Baxter and associates soon will be operating the Wheeler mine. Operations on the Champaign were suspended in January of this year, when a shipment by express, to the American Smelting & Refining Co.'s plant at Pueblo, returned 3.10 oz. gold, 894.1 oz. silver, and 14.9% lead. At the Wheeler mine Mr. Baxter reports that there is a 10-in. streak of ore in the back of the drift just beyond the breast of the tunnel, which is in virgin ground that assays 0.78 oz. gold, 8.43 oz. silver, and 43.8% lead.

IDAHO

Bellevue.—George Wyman of Boise, representing the company which has recently purchased the old dumps of the Queen of the Hills and Minnie Moore mines, states that the company will erect a mill on the property and use a flotation process for the recovery of the sulphide constituents of the ore.

Hailey.—The War Dance mine has cut another rich vein of lead-silver ore at a depth of 300 ft. After being intersected the vein was followed 100 ft., the last 40 ft. of the drift being in good milling ore. The old War Dance is credited with a yield of more than \$300,000 to pioneer operators. The ore runs about 70% lead, with 70 oz. silver per ton.

MISSOURI

Joplin.—What is probably a record in rapid shaft-sinking in this district has just been made at the High Five mine at Waco, where the fourth shaft has been completed to a depth of 180 ft. in the fast time of three weeks and five days. The shaft was sunk by B. Smith and A. Sease, expert men, working double shifts. No previous record of shaft-sinking, reported from any part of the district, equals this. Good ore had been discovered by drilling and a drift is being driven

to connect with the new shaft. This development makes certain a continuance of production at the High Five mine.

Two excellent finds of lead ore in the Webb City district are reported, one on the Hough land south of town and the other on the Troup tract at Prosperity. The Community Drilling Co. which has been prospecting the land for several weeks cut ore that is said to rival the Connor body opened by the company several months ago. Lead ore of exceptional richness in the new prospect was found at a depth of 50 ft., running through a 10-ft. stratum. Then at a depth of 100 ft. it was again penetrated for 30 ft. The discovery of rich lead ore on the Troup land was made by George and Fred Kusterer who are proving the land for themselves.

NEVADA

Battle Mountain.—The Buckingham Mining Co. reports that the Midland tunnel has intersected a new vein containing native copper and silver. The property is situated at Copper Basin. The Midland tunnel is in 360 ft. and will be driven a total distance of 3700 ft. to develop orebodies opened on the south side of Giant mountain. Orders are to be placed for a hoist, compressor, and drills. M. Burge is manager.

Pioche.—The experimental tailing-treatment plant recently erected at Bullionville, for the purpose of making experiments on the dumps there, has proved a success. A recent run included 19 tons of ore over two tables in a 24-hour period. Operations are under the supervision of G. E. Bateman, who is acting for San Francisco capitalists who have obtained a lease on the tailing owned by the Prince Consolidated company at the old Bullionville and Dry Valley plants. The experimental plant is equipped with one Vanner and one Overstrom table. From the 19 tons of tailing 1800 lb. of concentrate was obtained, this product assaying 35 oz. silver, 45% lead, and about \$5 in gold. The experiment will be carried further in order to determine the exact equipment which will be required to treat 100 tons of ore per day. The results of this experiment will affect the entire mining industry of Pioche. If it proves as successful as at present indicated the dump of every mine in the district may be made sufficiently valuable for further working.—George Snyder, manager for the Black Metal company, reports the shipment of 30 tons of high-grade ore to the smelter at Salt Lake. He expects the ore to average \$250 per ton in net returns. This ore, according to Mr. Snyder, was taken from the 25-ft. north stope. An average daily output of 75 tons is being taken from the mine.

Pioneer.—At a depth of 600 ft. the sulphide zone has been entered by the shaft of the Reorganized Pioneer Co. The discovery is considered the most important yet made in southern Nye county. W. J. Tobin, president, has arranged for the purchase of additional equipment preliminary to cross-cutting to pick up the extension of the Pioneer vein. —Operations have been resumed at the Consolidated Mayflower which is now under the control of W. J. Tobin and associates.

Reservation.—The tunnel of Review Silver Mining Co. has advanced 30 ft. and is expected to reach the junction of the main silver-lead vein and a gold-silver cross-vein soon.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

A. W. Allen is in Chile.

Walter G. Perkins is in London.

M. E. Merrill is at Los Angeles.

Walter Harvey Weed is in Cuba.

Charles O'Brien has returned to San Francisco from the Philippines.

Karl Eilers has opened an office in the Woolworth building, New York.

J. B. Annear has moved from Merced, California, to Bonanza, Colorado.

E. C. Bloomfield is now with the Burma Mines company at Namtu, Burma.

E. Gybbon Spilsbury has moved his office to 132 Nassau street, New York.

H. R. Bischoff, of the Bluestone mine, Mason, Nevada, is at Stillwater, Minnesota.

George H. Ryan, of Eureka, Utah, has taken a lease on a zinc property near Ely, Nevada.

G. Perry Crawford sailed from New York on May 15 for London, on his way to Spitzbergen.

A. B. Frenzel passed through San Francisco this week on his return from Arizona to Denver.

Thomas B. Stearns was in San Francisco last Wednesday on his return from La Jolla to Denver.

Alvin B. Carpenter, of Los Angeles, was in Plumas county examining copper prospects last week.

Harai R. Layng has been appointed superintendent for the Eureka-Holly Mining Co., at Eureka, Nevada.

R. P. Sharpe, of the Ripsey Copper Co., has moved to Indianapolis, Indiana, from Miami, Oklahoma.

A. J. McNab, manager for the Mason Valley Mines Co., has moved from Thompson, Nevada, to New York City.

Edwin E. Chase and his son, R. L. Chase, of Denver, are examining mines in the Magdalena district, New Mexico.

C. R. Morris, mill superintendent for the Mexican Mining Co. at Virginia City, Nevada, was at Salt Lake City recently.

F. G. Janney, general superintendent of mills for the Utah Copper Co. at Garfield, Utah, has returned from New York.

E. J. Franklin, consulting mechanical engineer for the Ray Con. Copper Co. and Chino Copper Co., is at Salt Lake City.

J. B. Tyrrell, of Toronto, has been appointed consulting engineer in Canada for the National Mining Corporation, of London.

W. W. Wishon has been appointed consulting engineer to the McCracken Silver-Lead Mines Co., in Mohave county, Arizona.

Francis B. Lawson (Major), chairman of the Mountain Copper Co., was in San Francisco this week, on his return from the Orient to London.

Tage Thomasson, metallurgist associated with several mining companies in Sweden, is visiting mines and metallurgical plants in Utah and Montana.

C. H. Abeling, formerly with the Stimpson Equipment Co. of Salt Lake City, is now mill superintendent of the Vipont Silver Mining Co., near Oakley, Idaho.

M. J. Gavin, refinery engineer to the U. S. Bureau of Mines, with headquarters at the Salt Lake station, spent several days during April in California.

Van. H. Manning, Director of the U. S. Bureau of Mines, has resigned to become Director of Research of the newly organized American Petroleum Institute.

S. Funakoshi, mining engineer with the Kuhara Mining Co., Ltd., of Tokyo, accompanied by Takio Shikamura, a

mining engineer connected with the Phelps Dodge Corporation for the past ten years, has been visiting mines and metallurgical plants in Utah.

Frank Anderson, mining engineer of Salt Lake City, has been appointed U. S. Mineral Surveyor of Arizona, by Frank B. Trott, Surveyor-General of that State.

Ross E. Douglass has resigned from the service of the Braden Copper Co. in order to form a partnership with A. H. Lawrence, with headquarters at Santiago, Chile.

A. W. Lehmann, manager for the Catume Copper Co. in Chile, is making a tour of the principal mining districts of the United States. He spent several days in Utah recently.

T. P. Billings, who has been mine engineer for the Bing-ham Mines Co. and the Eagle & Blue Bell Co. for 12 years, has been promoted to the position of general superintendent.

Cecil J. Brooks, metallurgical engineer engaged in research work in Sumatra, is making a tour of mining centres in the United States. He spent several days in Utah recently.

J. E. Spurr, editor of the 'Engineering and Mining Journal', delivered an address before the Michigan College of Mines, on April 14, the occasion being the graduating exercises.

J. H. Wiggins, assistant engineer to the U. S. Bureau of Mines, who has been stationed at the San Francisco office for the past six months, has returned to his headquarters at Bartlesville, Oklahoma.

R. E. H. Pomeroy, smelter superintendent at the Steptoe Valley smelter at McGill, Nevada, has resigned. On June 1 he will become associated with the Bonnot company, manufacturers of coal-pulverizing machinery.

E. C. D. Marriage, proprietor of the Pioche assay-office, was at Salt Lake City recently, on his way to his old home at Hatfield, England, on a visit. During his absence, Earl T. Godbe will have charge of the assay-office.

Charles Gammon, assayer in charge of the United States assay-office at Salt Lake City, has been promoted to the position of chief assayer in New York. Hugh T. Rippeto has been named his successor at Salt Lake City.

J. Fred Johnson, mine superintendent for the Chief Consolidated Mining Co. at Eureka, Utah, has been elected a director of the company to fill the place made vacant by the death of William P. Seager, of Houghton, Michigan.

Obituary

John S. MacArthur, the inventor of the cyanide process, died at Glasgow, Scotland, on March 16.

Oliver Sheppard Picher, president of the Eagle-Picher Lead Co., died of pneumonia, at his home in Winnetka, Illinois, on April 26. He was primarily a business man, and as such his judgment and ability found expression in the business that stands as a monument to his talent. He did not stop short of mastery of each detail of every department; he was an accountant, a metallurgist, a mining engineer, a chemist, a manufacturer, a financier, and his personality brought him thousands of friends in the business and technical world. He was born at Springfield, Missouri, but spent his boyhood and youth in California. He was a graduate of Leland Stanford University and the Columbia Law School. After finishing his law course he spent three years in the office of Elihu Root. Later he went to Joplin, Missouri, where his father, Judge O. H. Picher, was president of the Picher Lead Co. In 1906 he became secretary for the company, a position which he held for three years, until he was elected president. In 1916 the Eagle White Lead Co. and the Picher Lead Co. were merged into the Eagle-Picher Lead Co., and Mr. Picher became president. He was director and chairman of the finance committee of the American Zinc Institute, and belonged to numerous societies and clubs. He leaves a wife and four children.

THE METAL MARKET



METAL PRICES

San Francisco, May 4

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11
Copper, electrolytic, cents per pound.....	19.25
Lead, pig, cents per pound.....	9.50—10.50
Platinum, pure, per ounce.....	\$125
Platinum, 10% indium, per ounce.....	\$153
Quicksilver, per flask of 75 lb.....	\$97
Spelter, cents per pound.....	10.25
Zinc-dust, cents per pound.....	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

May 3.—Copper is inactive but steady. Lead is dull and unchanged. Zinc is quiet and steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending Cents	Pence
Apr. 27.....	112.00	65.00	Mch. 22.....	123.42
" 28.....	114.50	66.12	" 29.....	125.81
" 29.....	114.00	66.00	Apr. 5.....	126.50
" 30.....	111.50	64.50	" 12.....	123.75
May 1.....	110.00	63.75	" 19.....	118.12
" 2 Sunday.....			" 26.....	117.67
" 3.....	110.50	65.50	May 3.....	112.08

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	....	Nov.	101.12	127.57	....
June	99.50	110.50	....	Dec.	101.12	131.92	....

COPPER

Date	1918	1919	1920	Date	1918	1919	1920
Apr. 27.....	19.25			Mch. 22.....	18.10		
" 28.....	19.25			" 29.....	18.68		
" 29.....	19.25			Apr. 5.....	19.10		
" 30.....	19.25			" 12.....	19.25		
May 1.....	19.25			" 19.....	19.25		
" 2 Sunday.....				" 26.....	19.21		
" 3.....	19.25			May 3.....	19.25		

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	16.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.68	....
May	23.50	16.31	....	Nov.	26.00	20.45	....
June	23.50	17.53	....	Dec.	26.00	18.55	....

LEAD

Date	1918	1919	1920	Date	1918	1919	1920
Apr. 27.....	8.75			Mch. 22.....	9.10		
" 28.....	8.75			" 29.....	8.96		
" 29.....	8.75			Apr. 5.....	8.92		
" 30.....	8.75			" 12.....	8.78		
May 1.....	8.75			" 19.....	8.71		
" 2 Sunday.....				" 26.....	8.77		
" 3.....	8.75			May 3.....	8.75		

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	8.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	....	Nov.	8.05	6.76	....
June	7.59	5.32	....	Dec.	6.90	7.12	....

TIN

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	85.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	....	Nov.	73.67	54.17	....
June	91.00	71.83	....	Dec.	71.52	54.94	....

Prices in New York, in cents per pound:

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	85.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	....	Nov.	73.67	54.17	....
June	91.00	71.83	....	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	1918	1919	1920	Date	1918	1919	1920
Apr. 27.....	8.35			Mch. 22.....	8.91		
" 28.....	8.35			" 29.....	8.87		
" 29.....	8.35			Apr. 5.....	8.93		
" 30.....	8.30			" 12.....	9.17		
May 1.....	8.30			" 19.....	8.94		
" 2 Sunday.....				" 26.....	8.37		
" 3.....	8.30			May 3.....	8.92		

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	7.78	7.44	9.58	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	7.78	7.81	....
Mch.	7.67	6.63	8.83	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	....	Nov.	8.75	8.12	....
June	7.92	6.91	....	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	Date	1918	1919	1920
Apr. 8.....	100.00			Apr. 20.....	100.00		
" 13.....	100.00			" 27.....	97.00		
				May 4.....	97.00		

Monthly averages

Date	1918	1919	1920	Date	1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	....	Nov.	120.00	78.00	....
June	112.00	94.40	....	Dec.	115.00	95.00	....

FINANCING FOREIGN TRADE

The recent report of the National Committee on European Finance to the Chamber of Commerce of the United States has this to say regarding the need for foreign trade and the means of financing:

"The large investor, corporate and individual, is largely unavailable because of the present tax situation. Under the existing Federal income tax, a return of 5% without tax deductions (which can be obtained from fully tax-exempt State and municipal securities of prime character) is more attractive than domestic or foreign investment subject to tax. However, modification and reduction in excess-profits tax and income tax should enable those with large incomes to invest at least a part of surplus in securities of corporations organized for internal development or to promote foreign trade. The small investor is not saving. Closely related is the almost universal speculative tendency—an insuperable obstacle to substantial sale of investment securities. Even if substantial thrift were practised among small investors, resulting funds would not be large enough without the large investor, now substantially legislated out of the investment market. It has been difficult to make progress with investment education, as applied to foreign investment, when competition for limited domestic capital makes it impossible for American companies to secure funds they urgently need. The Treasury has invested nearly ten billion in Europe. Fiscal policies of our Government are still closely bound up with American business operations, and will have intimate bearing thereon for years. There is a widespread opinion that the Government should be a party to councils of bankers and business men when fundamental policies of foreign financing are shaped. It will be impossible to stimulate general popular support for foreign financing until governmental sanction and co-operation are afforded.

"Definite understanding should be arrived at regarding the policy the Government will pursue in protecting American investments in foreign countries. Continued existence of a state of war has not tended to improve that confidence in conditions overseas which must always be the basis for credit judgments. Developments have brought new political units, and new relationships. Reasonable grounds for business confidence in European conditions cannot exist until this country comes to some definite political understanding with the nations of Europe, with whom our own economic interests are inextricably linked.

"As to security in Europe for credit, distinction must be drawn between larger and more soundly established nations, such as Great Britain, France, Belgium, and Italy, and possibly Germany, and a numerous group of new small nations of unproved stability. In the latter a degree of political risk is involved beyond that reasonably undertaken by ordinary business. Great need for credit exists where credit risk is greatest. Very few American interests are sufficiently informed as to these smaller countries to undertake credit arrangements directly. A proper course might be to enter carefully safeguarded co-operative arrangements with larger political units of Europe, or private enterprise in larger European countries.

"A most important problem is how to extend further credit without added inflation at home. This country can extend further credit solely by curtailment of its own expenditures and increase in its own production."

MONEY AND EXCHANGE

Foreign quotations on May 4 are as follows:

Sterling, dollars:	Cable	3.87
	Demand	3.86½
Francs, cents:	Cable	6.10
	Demand	6.09
Lire, cents:	Demand	4.65
Marks, cents		1.79

Eastern Metal Market

New York, April 28.

The damaging effect of the railroad strike is still apparent and business in general is light in all markets. Prices have fallen in some cases.

Demand for copper is negligible, except for export, but prices are fairly firm.

There is almost no business being done in tin at any price, but quotations are steady.

In lead the situation is complex and prices vary according to sellers and position. Prompt metal, New York, is scarce.

The zinc market is stagnant and prices are lower.

Antimony is quiet and unchanged.

IRON AND STEEL

The market is not merely handicapped by the forestalling of deliveries and the consequent forcing into the third quarter of much that should be shipped in the second—and all in the face of practically negligible stocks in the hands of consumers and distributors—but it is clouded by further threatening labor difficulties. To add to the unsettlement of the contemplated strike on May 1 of molders, machinists, and other crafts in some of the Middle Western cities is the continued labor agitation among the steel workers in the same sections.

The price situation is naturally strong. Conditions have not been conducive to speculative buying and world needs are still unsatisfied. And yet exceptional transactions are noted in which an independent mill has sold a large tonnage of steel bars to an agricultural implement maker for the last half at 2.90c., Pittsburgh, and has subsequently made quotations at 2.35c., the price of the Steel Corporation. Another mill has met the Steel Corporation price on shapes of 2.45 cents.

COPPER

This market is stagnant but prices are practically unchanged. Electrolytic and Lake copper are quoted more or less nominally by the large producers at 19.25c., New York, which is firmly maintained. There is an outside market where quotations are reported as low as 18.37½ to 18.50c., New York, for electrolytic, but almost no business is being done. The railroad strike has, of course, interfered with operations of refineries as well as shipments of copper on contract, and there is no reason for any one to buy. Recovery from the strike has not been sufficient to be noticed yet. Added to these conditions are strikes at certain mines and smelters which are interfering with the flow of crude copper to refineries as well as with production. Besides this there is a strike at Waterbury, Connecticut, which has tied up all the large brass plants there. It will be some days and perhaps weeks before a recovery sets in. While domestic business is dead, there continue to be almost daily sales to foreign nations, including Germany.

TIN

Conditions in this market continue unchanged. There has been and is little doing and sales have been very light indeed. The dominating factor has been the railroad strike which has effectively put the brakes on business. Tin consumers have had no occasion to enter the market and the strike has seriously affected consumption. Consumers also have troubles of their own of a different nature, and it is estimated that they have lost by the strike a month's output in their business. Conditions, particularly railroad shipping, has just commenced to improve. Yesterday and Monday there was more interest by consumers in future-shipment metal, but no business is reported to have materialized. Daily prices for spot Straits have been fairly regular around 61.50c., New York, the past week, but a drop in exchange

yesterday caused a drop in Straits tin which was quoted yesterday at 60.50c., New York. Arrivals thus far this month have been 3008 tons, with 3096 tons afloat.

LEAD

The market presents a peculiar situation and prices have a wide range. The leading interest has not lowered its quotation which remains at 9c., St. Louis, or 9.25c., New York, for early delivery. The other extreme proceeds from second hands who say they are offering metal from consumers at 8 to 8.25c., St. Louis, who bought too heavily for future delivery. This statement will persist among many who say that this is impossible and brand it as speculative operations. Contrasted to these prices are those for spot and prompt New York where the metal is very scarce, due to the railroad strikes and embargoes. For a fair business on Monday, 9 to 9.25c., New York, was realized and yesterday sales were made at 9.30c., New York. Demand in general is quiet except from needy consumers for early use. We quote the market for early delivery at 8.40c., St. Louis, or 8.75c., New York.

ZINC

The market has been erratic, prices varying not only from day to day but even at considerable spread in the same day. Quotations for prime Western fell to 7.95c., St. Louis, during the week, rose to 8.10c. on Monday, and fell back to 8c., St. Louis, yesterday, but very little business was done. London continues to make the market here, and prices there have been changeable. Foreign exchange has also had its influence as usual, the recent rapid decline of 15 to 20 points being partly responsible for the lower market here. Large producers are not interested in present levels and are well sold up to July. There is very little interest in buying beyond this date. We quote prime Western yesterday (Tuesday) at 8c., St. Louis, or 8.35c., New York, with brass special selling at 8.75c., New York, and Grade A at 9.50c.

ANTIMONY

In a quiet market the better grades are quoted at 11c., New York, duty paid, for wholesale lots. Poorer grades are held at ¼ to ⅝c. lower.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted at 33c. from the leading interests and at 31.50c., New York, from outside sellers, both for wholesale lots for early delivery.

ORES

Tungsten: The market is quiet and but little business has been done. The minimum price on low-grade ores is \$7 per unit. Most buyers and sellers are waiting for some action on the tariff matter.

Ferro-tungsten is quiet at 90c. to \$1.15 per lb. of contained tungsten.

Molybdenum: In a dull market quotations are unchanged at 75c. per lb. of MoS₂ in regular standard concentrates.

Manganese: Quotations are unchanged for high-grade ore at 65 to 80c. per unit, seaboard, depending on the delivery. No transactions have been reported but demand for good-quality ore is strong.

Manganese-Iron Alloys: The ferro-manganese market is quiet but strong at \$200, delivered, for domestic alloy for last half and \$195, seaboard, for a limited quantity of British alloy for shipment from August on. For prompt and second quarter delivery \$225 to \$250 rules. There is very little business except for early delivery and here the amount available is small. The strike has seriously interfered with the shipment of alloy on contract. Spiegeleisen has sold at \$75, furnace, for early delivery.

Company Reports

LA ROSE MINES LIMITED

Report for the year ended December 31, 1919.

Property: mines in the Cobalt district include the La Rose, Violet, Princess, University, and others.

Operating Official: G. C. Bateman, general manager.

Financial Statement: gross settlements for the year, \$308,159. Adjustment for difference in stocks at beginning and end of the year make production \$356,124. Costs were \$325,919, and including miscellaneous income the profit was \$51,736.

Dividends: none during 1919.

Development: in the La Rose mine the only development work was a drift on the Powder-house vein, which disclosed a limited amount of ore of milling grade. The No. 3 shaft, which has not been re-opened since the strike, will be pumped out, as there is still a small quantity of known ore left in the workings.

At the Violet mine development was continued throughout the year, and a new level on the vein north of the shaft was opened at 250 ft. A short shoot of milling ore was found in the conglomerate on this level, but no high-grade. The ore-shoot, found the previous year on the 330-ft. level south of the shaft, was developed from a raise above the 410-ft. level, and showed profitable mill ore, with some high-grade. A limited production from these two veins was maintained.

Production: a summary of the production follows:

Mine	Dry tons	Silver, oz.	Net value
La Rose	22	30,117	\$47,589
Princess	9	6,648	8,478
Violet	23	17,494	18,351
Concentrate	661	235,059	246,198
Total	715	289,318	\$320,616

INSPIRATION CONSOLIDATED COPPER CO.

Report for the year ended December 31, 1919.

Property: mine and mill at Miami, Arizona.

Operating Official: Thomas H. Donahue, general superintendent.

Financial Statement: sales of copper, \$11,045,222; mining expenses, including development, \$3,222,261; reduction, including transportation of ore, \$3,615,690; refining and selling expenses, including transportation of metals, \$2,777,416; administration expenses and Federal taxes, \$272,523; copper on hand at beginning of year, \$2,978,099. Total, \$12,865,990. Copper on hand at end of year, \$6,118,332. Depreciation on buildings and equipment, \$348,633. Interest received, \$168,038; income from investments, \$69,660; balance, income for year, carried to foregoing balance sheet, \$4,186,628.

Dividends: \$7,091,802 during 1919; total to date, \$33,078,866.

Development: during the year a total of 21.33 miles of underground openings was driven, making a total of 149.18 miles driven in the property to the end of the year, and 6.13 miles of underground workings was destroyed in the process of mining. During the year work on the drift on the 600-ft. level through the Live Oak property, which had been discontinued in 1913, was resumed, and in the latter part of May the drift was completed. The total length of the drift from Live Oak to the main shaft is 7888 ft. During the period 248 ft. of the 600-ft. haulage level was widened so as to relieve traffic congestion. In addition to the above, 3295 ft. of haulage drifts was driven. The development work during the year was confined within the area previously prospected by churn-drilling, so that no new discoveries were made nor was any additional ore developed. The erection of the 35-ton experimental leaching

plant started in 1918 was completed and operations were begun on June 24, 1919. The results of the tests upon about 5000 tons of oxidized and mixed ores have been satisfactory, and indicate that the oxidized ores of the company can be readily and economically treated by sulphuric-acid leaching. The experiments have likewise indicated that the copper can be economically recovered by electrolytic deposition.

Production: the output of copper for the year was 78,038,306 lb., obtained from the treatment of the following ores: concentrating ore, 4,151,806 tons; main shafts, ore to smelter, 18,338 tons; Live Oak, ore to smelter, 3680 tons; Keystone, ore to smelter, 1807 tons; total, 4,175,631 tons.

FRANKLIN MINING CO.

Report for the year ended December 31, 1919.

Property: mine on Portage lake and mill at Point Mills, Michigan.

Operating Official: Enoch Henderson, superintendent.

Financial Statement: mining expense, \$164,665; surface and stamp-mill expense, \$153,510, making, with miscellaneous, \$331,036. Income from copper sold and miscellaneous sources, \$192,822. Net deficit \$192,930.

Dividends: no dividends in 1919. Dividends to date, \$1,240,000.

Development: production was discontinued in May 1919, and since that time operations have consisted of taking care of the plant, keeping the mine free of water, and development work on the Pewabic amygdaloid at the bottom of No. 1 shaft. The shaft was sunk from the 37th to the 39th level and about 300 ft. of drifting done at the 39th level, which is 3900 ft. below the surface measured on the dip of the lode. The first level above the 39th on which any extensive stoping has been done is the 30th, and here the ground from 600 ft. north of the shaft to the present end of the drift at 1600 ft. north of shaft averaged good. This means that there is practically 900 ft. of unstopped ground above the present bottom opening, with the probability, judging from the 30th level, that the character of the ground will improve as drifting is continued north.

When production stopped there were better than 200,000 tons of excellent rock opened on the 18th and 19th levels at the bottom of No. 2 shaft on the Allouez conglomerate.

Production: tons of rock hoisted, 120,938; tons of rock discarded in rock-house, 11,314; tons of rock stamped, 109,565; pounds of refined copper produced, 1,062,879.

NEW IDRIA QUICKSILVER MINING CO.

Report for the year ended December 31, 1919.

Property: mine and reduction plant in San Benito county, California.

Operating Official: H. P. Baker, general manager.

Financial Statement: net proceeds of sales of quicksilver, \$560,179. Operating expense, depreciation, and depletion, \$615,686.

Dividends: \$25,000 during 1919, making total to date \$2,705,000.

Development: a new reduction plant, consisting of five rotary-kilns and condensing systems, was completed during the year, including the placing of conveyor-belts, crushers, etc., also an aerial tramway to carry away the burned ore from the furnaces. This new plant has a roasting capacity of from 400 to 500 tons of ore per day, and with the mill unit gives us the largest quicksilver reduction plant in America.

Production: the total production for the year was 7400 flasks, as compared with 10,700 for the previous year. This smaller production was due to unsettled market conditions in the early part of the year, which necessitated curtailing operations. This resulted in a loss of production of approximately three months, or 2500 flasks.

Book Reviews

Technical Writing. By T. A. Rickard. Pp. 174, index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$1.50.

Few engineers, whether they be college-trained or self-educated, are able to express their thoughts clearly on paper. The undergraduate in a technical school is seldom compelled to devote any time to English composition, and even if he is, impatience at what seems to him to have no direct bearing on his principal studies militates against his taking interest in the subject. The self-educated man is even less likely to give any part of his limited time to something that appears to him to be unnecessary. However, after a few years, or even less time, spent in practising his profession, the young engineer is likely to discover that the ability to write well is not such a non-essential, after all. Whether he has to write a report or a technical article, he finds himself unable to express his ideas clearly and in such a way as to carry conviction. If, as a result of such an experience, he tries to improve himself, he finds that the ordinary textbook on English composition does not fit his needs. The usual result is that he abandons the task, writes as little as possible throughout his career, and writes that little poorly. The consequence is that accumulated technical knowledge, which is the sum of every man's experience, is lacking in the contribution that he might make to it, and that he himself is deprived of the friends, and possibly even the technical success, that the publication of well-written reports and articles might bring to him. The present volume has been written to fill the needs of the engineer that wishes to improve his writing abilities.

As the author states in his opening chapter, "Science is not divorced from literature and no valid reason exists why technology should be regarded as if it were legally separated from good English". The book not only shows the incorrectness of this belief, but also indicates the means whereby a better understanding between the two contracting parties may be attained. Good technical writing is shown to be not a matter of literary frills, but rather one of expressing the meaning of the writer so that the reader can grasp it without unnecessary mental effort. The rules given for accomplishing this end are necessarily many, but they are all based upon the fundamental principle, 'Remember the reader'. The titles of the chapters on Naturalness, Clearness, and Precision, respectively, are self-explanatory. In the discussion of Superlatives and Other Diluents, such as 'considerable', 'probably', and 'rather', the indiscriminate use of these words is condemned. Similar disapproval is expressed in the next chapter regarding the use of other meaningless words, a use that serves merely to weaken the sense of whatever statement is made. In the chapter on the relative pronouns, the student will be enlightened regarding the clearness obtained by the correct use of these words, which are so frequently used incorrectly in ordinary speech and writing. An important feature of the chapter on prepositions is the discussion of the use of single-word verbs in place of the preposition-verbs whose prepositions so often show a tendency to land at the end of the sentence. Hyphens as aids to clearness, particularly in technical writing, are discussed in the next chapter. The chapters on Slovenliness and Jargon appropriately follow each other, and the author has found no difficulty in collecting plenty of examples to illustrate the faults that he describes. The titles of the remaining chapters, namely, The Construction of Sentences, Composition, and Style, need no comment. Although the book is based on a series of lectures delivered before the mining students of the University of California, and most of the illustrations are naturally drawn from mining engineering, the book should be in the hands of everyone that

writes technical English, whether in book, magazine article, or trade catalogue.—A. T. P.

A Glossary of the Mining and Mineral Industry. By Albert H. Fay. Pp. 754.

Those engaged in the mining industry have long felt the need for a comprehensive glossary of the terms in use. This want has been met by Albert H. Fay, mining engineer to the U. S. Bureau of Mines, the author of Bulletin 95, 'A Glossary of the Mining and Mineral Industry', which contains about 20,000 terms and 30,000 definitions covering all phases of coal and metal mining, quarrying, metallurgical plants, coke-ovens, oil and gas wells, geology, and mineralogy. The words are arranged alphabetically in true dictionary style, there being no industrial grouping. Only one glance is necessary, therefore, to find any desired term. The type and style of composition are such as to render it easy to find the word, and read the definition. A cursory glance through the 754 pages reveals painstaking study in assembling definitions from many and varied sources, and inserting proper cross-references. The scope of the work includes all English-speaking countries, as well as much that is Latin-American. Usually the name of the State, province, or country is given, showing where the more provincial terms originated or where they are extensively used. In most cases the name of the author quoted is given in parenthesis at the end of the definition, thus making it possible to trace the term back to the publication in which it previously was defined. About 150 authors are quoted, as indicated by the list of publications cited, 100 of which publications contained glossaries relating to some phase of the mining industry. The glossary contains many words that are more or less obsolete and this feature may be considered an advantage rather than a detriment, as the older literature contains many terms that are not now current. The scientist engaged in research work is always glad to know where the older terms are properly defined. This feature of the glossary is highly commendable. Some of the terms that have figured in mining litigation, as for example, 'abandonment and forfeiture', 'apex', 'fissure', 'lode', 'vein', and scores of others, have been given special attention, a number of similar but slightly different interpretations being given and many court cases cited wherein the decisions were rendered. These court citations, in addition to definitions from other sources, add to the value of the publication from a legal standpoint. The large number of Spanish, Mexican, and South American terms makes the book doubly valuable for engineers and others engaged in the mining industry of our sister Latin-American republics.

Handbook of Ore Dressing. By A. W. Allen. Pp. 242, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

The title of the book is doubtless misleading to many. Ore dressing in this treatise refers "to those preliminary mechanical or semi-mechanical operations that precede or operate concurrently with a specialized method of extraction or recovery". Accordingly the author considers the roasting of ore and concentrate in its mechanical aspects but does not discuss amalgamation. Concentration by means of jigs, tables, and flotation machines is likewise ignored. However, having adjusted his idea of what 'ore dressing' may signify, the reader may find much of value in the book, principally a summary of the machines and equipment used for the conveying, feeding, crushing, grinding, classification, and dewatering of ore and ore pulps. Many data regarding the operations of the machines enumerated and profuse illustrations, both drawings and photographs, add to the value of the work. While it is impossible in so small a volume to go into great detail on any particular subject, a very good general survey of the more recently developed machines and methods, as well as those of an earlier day that still survive in present practice, is presented.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MAY 15, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page
EDITORIAL	
NOTES	697
MINERALS SEPARATION UNDER SCRUTINY.....	698
Proceedings before the Federal Trade Commission. Mr. John Ballot's evidence. Number of companies licensed by Minerals Separation and the number considered as 'infringers'. Dr. Gregory's description of the flotation process. T. J. Hoover's book.	
THE DAY AFTER	698
Comment on the primary election in California. Reasons for Mr. Hoover's defeat. His dignified attitude. Mr. Johnson as the spokesman of discontent. Where the candidates obtained majorities. Ignorance concerning Mr. Hoover. Mean attacks by the local newspapers.	
WHAT THE MINERS THINK.....	699
The resolutions passed by the recent International Convention at Seattle. American Mining Congress commended for proceeding against Minerals Separation. J. F. Callbreath complimented. Protection for war minerals. Condemnation of excess-profit tax. Protest against delay on War Minerals Relief. Protection of Americans in foreign countries. Expulsion of anarchists. Rating of mining businesses by Dun and Bradstreets. The scope of mining conventions. The publication of books for the prospector. The bonus on new gold.	
DISCUSSION	
FILING OF MINE REPORTS	
By Kirby Thomas	701
The advantages of a plan for the compulsory filing of mine-maps. Might be filed under seal.	
A PROTEST	
By Frank H. Probert.....	701
The wearing of 'cords' at the University of California. A tradition.	
THE CORPORATION AND THE INDIVIDUAL	
By P. B. McDonald.....	701
The reason for antagonism toward corporations. Industrial hierarchy.	
THE FUTURE OF CHROMITE IN THE UNITED STATES	
By C. S. Maltby.....	702
Reference to a letter by S. H. Dolbear. An exception to his statements.	

ARTICLES

THE BUNKER HILL ENTERPRISE—IX	
By T. A. Rickard.....	703
Simeon G. Reed acquires the property; Victor Clement is engaged as manager. Financial difficulties. John Hays Hammond and W. H. Crocker. Chronological record of officials. F. W. Bradley; Albert Burch; Stanly A. Easton. The transfer of the shares. The romantic story of the "belle of that frontier community". Graphic record of the economic history.	
PROCEEDINGS AGAINST MINERALS SEPARATION BEFORE THE FEDERAL TRADE COMMISSION	710
John Ballot testifies. The relations of Beer, Sondheimer & Co. and Minerals Separation. Standard licenses and exceptions thereto. Dr. Gregory on the stand. Methods of getting evidence. "A jolly simple process."	
OPERATION OF THE CASE OIL-FIRED ASSAY-FURNACE	
By F. Borzynski	713
Directions for manipulation of the furnace.	
MINING IN NARROW STOPEs	
By E. A. Colburn, Jr.	715
The problem is to get clean ore. Careful supervision. Some practical suggestions.	
ENGINEERING ACTIVITIES OF UNIVERSITIES AND GOVERNMENT BUREAUS	717
Criteria for judging existing policies in respect to these activities. "Institutionalizing of engineering service" is undesirable.	

NOTES

PERUVIAN COPPER & SMELTING CO.	709
LEAD DEPOSITS IN SOUTH AFRICA	714
CHROMITE PRODUCTION IN 1919	718

DEPARTMENTS

REVIEW OF MINING	719
THE MINING SUMMARY	727
PERSONAL	728
OBITUARY	728
THE METAL MARKET	729
EASTERN METAL MARKET	730
DIVIDENDS FROM MINES, UNITED STATES AND CANADA	731
COMPANY REPORTS	732
INDUSTRIAL PROGRESS	733

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.

Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.

Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries in postal union 25s. or \$6.



Limited Floor Space? *Follow the Example of the Belmont Surf Inlet Mines, Ltd.*

They are using six No. 9 Double-Deck Wilfleys with the excellent results so characteristic of Wilfley concentration wherever practised.

Practically 100% added capacity is obtained per unit of floor space with no loss in efficiency. The lower deck is visible because of the wide space between the two decks.

WILFLEY
THE TABLE



If you have a concentrating problem—write our engineers. There is a type of Wilfley for every metallurgical requirement.

Adaptations can be made to suit the limitations of your plant and the character of your ore.

Over 22,000 Wilfleys are now in use.

The Mine and Smelter Supply Company

DENVER

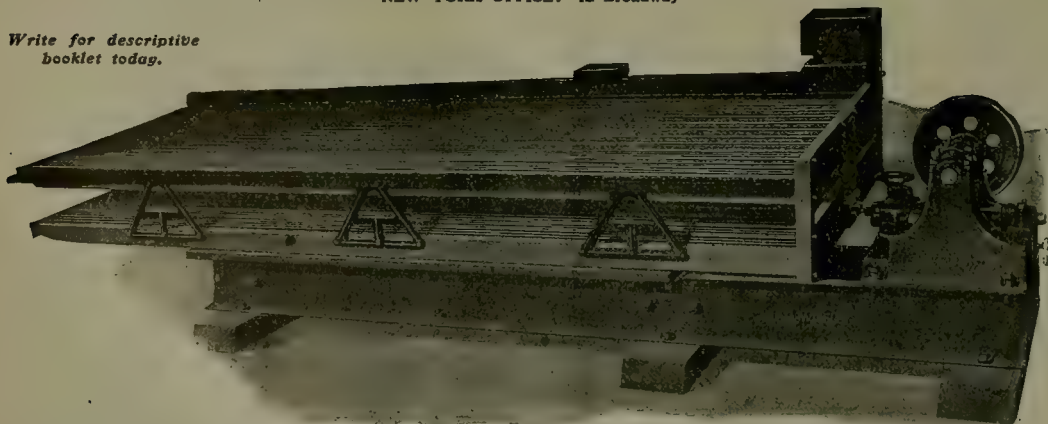
A Service Station Within Reach of You

SALT LAKE CITY

NEW YORK OFFICE: 42 Broadway

EL PASO

Write for descriptive booklet today.



No. 9 Double Deck Wilfley Table



T. A. RICKARD, . . . Editor

IT is interesting to note that at the recent annual dinner of the Institution of Mining and Metallurgy in London, the first occasion of the kind since 1914, the chairman and president, Mr. Hugh K. Picard, stated that within five months of the declaration of war no less than 1000 out of the 2492 members joined the active forces, that is, 40%. He added regretfully that 113 members made the supreme sacrifice, not counting many others whose death was due to war service at the base.

TWO and a half million railway employees have presented a demand to the Federal Railroad Labor Board for a minimum wage of \$2500 per annum, and yet the average citizen is not perturbed, because he thinks in his ignorance that the demand does not affect him. It is a curious fact that in national, as in international, affairs the average citizen thinks his own life is delightfully detached from the troubles and complications that menace other parts of the community or other countries. In large measure the innate selfishness of man is at the bottom of most of the difficulties under which civilization staggers today; in short, civilization is only a half-baked product of human endeavor.

APPARENTLY the Mexican primary elections are almost ended and Señor Venustiano Carranza has failed to win a nominating delegation. Next will come the convention itself, which may involve further electioneering of the approved Mexican kind, with alarums and excursions, a little fighting and a lot of looting, ending in secessions of military leaders from one side to the other. At this time of writing it appears that General Alvaro Obregon and Señor Pablo Gonzales are in the lead, because they have marched at the head of their troops into Mexico City. Anything is better than the Carranza regime. General Obregon is a man of sense; we are hoping that he may succeed in winning the 'election' and be placed in a position enabling him to restore peace and order in his distracted country. We believe that he favors the assistance of American capital in developing the mineral resources of Mexico.

ACCORDING to the 'Financial Times', the Indian gold-mining companies have made a new contract with the Government, beginning May 15, whereby the Government of India has the option to purchase the whole or a portion of the output of the Kolar mines at

the London market price calculated at the current rate of rupee exchange, the gold being delivered, as heretofore, at the Bombay mint. It is part of the arrangement that in the event of the Indian government not acquiring the whole of the output, the companies shall be free to dispose of their gold in other markets. Until further notice, the Government has decided to take 75% of the gold output, so that arrangements will be made to dispose of the remaining 25% in India at the best price. Payment for the gold acquired by the Government will be made as to two-thirds in India at the ruling rate of exchange and as to one-third in sterling in London. While these arrangements do not place the Indian gold mines in as favorable a position as those in South Africa, they are much better than any previous method of realization on their output.

IN a recent editorial upon the gold bounty, we referred to Mr. Vanderlip's contention that it was undesirable to increase the gold reserve because it would permit the Federal Reserve banks to increase their note issue to the extent of a ratio of 40% gold to notes, and we proceeded to suggest that this was a weak argument because an increase, say, of 50 million dollars in our gold output would legalize an increase of only 20 millions in the note issues of the banks. This was an error, of course; the gold reserve has to be at least 40% of the note issue, not the reverse; therefore 50 millions more of gold produced would warrant a further issue of 125 millions in notes. The error does not vitiate our argument, which is that the increase of paper money, whether of 20 millions or of 125 millions, would be of small consequence to a country that has a foreign commerce amounting to 14 billion dollars per annum.

FREDERICK G. COTTRELL has been nominated by the President to the directorship of the U. S. Bureau of Mines in succession to Mr. Van. H. Manning. The nomination was sent to the Senate on May 5 and will be confirmed in due course. Dr. Cottrell was assistant to his predecessor and therefore comes into office with ample knowledge of its duties and responsibilities. He is still a young man, being only 43, so that he will be enabled to establish a personal tradition of good and useful work in his important office. He has the habit of working hard and the excellent characteristic of being able to stimulate his associates to earnest work; his

executive ability and business acumen remain to be tested, but we do not doubt he will rise to the occasion. A graduate of the University of California in 1896, he received his doctorate in philosophy from the University of Leipzig in 1902. Subsequently, while instructor and assistant professor of physical chemistry at Berkeley, he began a research into the electric precipitation of smelter fume, and made the experiments at the Selby plant that were described in our pages in 1908. Later the same device was used to prevent dust from kilns at cement-plants from damaging orange groves in southern California. Since then the Cottrell 'precipitator' or 'treater' has been introduced at modern metallurgical plants all over the world, from Anaconda to Ashio. The inventor showed a rare kind of public spirit in turning over his patent-rights to a Research Corporation, formed for this purpose, in order to encourage further scientific investigation of immediate industrial importance. In 1911 Dr. Cottrell was appointed chief physical chemist to the Bureau; in 1914 he became chief chemist; in 1916, chief metallurgist, and in 1919, assistant director. He has earned his promotion to the highest office in the Bureau and we feel sure that under his direction this important scientific branch of the Government will prove itself increasingly helpful to the welfare and progress of the mining industry.

Minerals Separation Under Scrutiny

In this issue, by courtesy of the American Mining Congress, we publish a summary of the evidence given in the proceedings taken by the Federal Trade Commission against the Minerals Separation companies. The hearings are not ended, and we expect to record the future proceedings in due course. It is well that this information should be made public. We have read the verbatim reports, which are voluminous. Mr. Ballot stated that those whom he calls "infringers" are treating "from thirty to forty million tons of ore". He also said that the number of American mines using the process without license was "either 450 or 540"; he could not recall the exact figure. Only 120 are under license in the United States. The Anaconda Copper Mining Company collects the royalties payable by the companies "associated with it under the agreement" with the Minerals Separation company. These "associated" companies are the Inspiration, New Cornelia, Greene-Cananea, Calumet & Arizona, Arizona Copper, and Consolidated Coppermines. Settlements for infringement have been made by the Hecla, Tamarack & Custer, Hercules, and Bunker Hill & Sullivan companies. The Anaconda has recovered 100,000,000 pounds of copper by flotation; of this, 43,398,250 pounds is estimated, by Mr. Ballot, as copper that would otherwise have been lost in the tailing. Later Mr. Ballot decreased the estimated capacity of the infringers to something between 28,000,000 and 30,000,000 tons. Evidently he does not know; for the margin between 28 millions and 40 millions, the extreme figures, is so large as to suggest lack of adequate data. The Phelps Dodge Corporation has

been operating under a group agreement with the Minerals Separation people since December 31, 1917. We are amused by Dr. Seth Gregory's description of the flotation process as "so jolly simple, you know". Evidently he talked a lot of piffle before the Examiner. The serious part of his testimony was the acknowledgment that the licensees are forbidden to communicate any details of their operations to a third party. That clause, needless to say, was not imposed upon the Anaconda and Inspiration companies. The Minerals Separation people reserved the right to edit anything written by a licensee or an employee of a licensee, and, as we know, they attempted to prevent the publication of information that did not trespass upon their rights. As to Mr. T. J. Hoover's book, it appears that Mr. Ballot suggests that only "some" of his decisions in regard to the text were "respected". We have excellent reasons for knowing that Mr. Hoover did respect the agreement made by him to delete matter that Messrs. Ballantyne and Gregory deemed prejudicial to the proprietary interest of their company; yet Mr. Ballot asserts that he has not read Mr. Hoover's book, nor, of course, any later books on the subject to the commercial exploitation of which he has devoted 17 years of his life. Before the hearings are concluded, we hope to publish Mr. Hoover's testimony and that of others; meanwhile it is well to note that the first resolution passed by the Mining Convention at Seattle thanks the American Mining Congress for having instituted these proceedings against Minerals Separation.

The Day After

The Republicans of California have chosen Senator Johnson in preference to Mr. Hoover as their nominee for the Presidency. The result of the election was declared after we had gone to press last week. To us, of course, it is disappointing; it shows the strength of the political machine created by Mr. Johnson, as was shown likewise in the elections of 1916, when Mr. Charles E. Hughes was rebuffed so severely and Mr. Johnson himself stepped from the governorship to the senatorship. Mr. Hoover's friends are amateurs in politics, and that was one reason why they—and we include ourselves—did not realize the strength of the political machine that was working against him. It may be that Mr. Hoover's pronouncement of his preference for the Republican party came too late, and perhaps it was not strong enough for the purpose of the primary election. That could not be helped; it was part of the logic of events. The statement issued by Mr. Hoover the day after the Californian election was dignified and good-tempered. We think he over-estimates the importance of the League of Nations as an issue on this Coast; the farther west one goes, the feebler becomes the interest in European affairs. Senator Johnson's frothy provincialism, following upon his care not to hurt pro-German sensibilities, has helped him politically in certain quarters where votes are numerous. (Mr. Hoover refers to his opponent as having saved the State from "vicious corporation control" when Governor and to his "too narrow vision on

our international necessities". That view of world affairs Mr. Johnson shares with thousands of his constituents. They would like to wash their hands of the mess in Europe; they would like to believe that the sorrows and miseries on the other side of the Atlantic are none of their business; they are glad that the continent, as well as the sea, separates them from responsibilities that they wish intensely to ignore. To them the economic solidarity of the civilized nations is a figment created by persons who are not 100% American. The fact that Mr. Hoover has shown a rare understanding of economic problems and that he has had the experience fitting him for guiding this nation during the days of economic stress so plainly visible on the horizon—all this does not interest them. The Senator voices their discontent with things as they are, he waxes indignant over the blunders of our present Chief Executive, he seems to be angry with all those accountable for making life so difficult and costly at this time. Johnson is the apostle of discontent; Hoover stands for thrift, for putting things in order, for a recognition of world realities. The one obtains a ready, because it is an unthinking, response; the other appeals most to the thoughtful man. In Berkeley, where we live, it is interesting to examine the vote by precincts and to see how 'down-town' supported Johnson just as overwhelmingly as 'up-town' voted for Hoover. In a university city like Berkeley 'up-town' does not connote wealth, it means the homes of professors, engineers, and professional men and women generally, plus a few business-men to whom an academic neighborhood is agreeable. Unfortunately Mr. Hoover is not nearly so well known in California as is the Senator. The Berkeley 'Gazette', which is a fairly intelligent newspaper, speaks of Herbert Hoover as "that estimable civil engineer". It is as if we spoke of Mr. Johnson as "that charming admiralty lawyer". The newspapers of San Francisco were for the Senator and they took care that the public did not get to know much about Mr. Hoover; on the contrary, they fed the prejudice arising from his long residence abroad, due, as our readers know, to the exigencies of the mining profession. The 'Chronicle' said: "Mr. Hoover became known to the American people as the beneficiary of the sentiment created by the boundless generosity of that people"; that is, Mr. Hoover is trading on a sentiment for which he deserves no particular credit. Not many who read this jibe appreciated its untruth, although they may have guessed at its meanness. Mr. Hoover became known to the American people first because he organized measures of relief for American refugees passing through London, as soon as the War began in Europe. Mr. Hoover's executive ability saved the day, not the "boundless generosity" of anybody. Next Mr. Hoover set to work to organize relief for the Belgians; again it was his executive ability and the assistance he obtained from a number of American mining engineers, in the first place, that made the Commission for Relief in Belgium synonymous with efficiency and effectiveness. Again the 'Chronicle's' "boundless generosity" is irrelevant. Mr. Hoover risked his own fortune at the start, until he obtained recognition and assistance from the British government. The Ameri-

can government did not participate directly, financially or otherwise, until after the United States entered the War. At the end of 1916, out of the \$227,500,000 devoted to Belgian relief, the people of the United States had subscribed only \$10,000,000, and the profit made in this country on the \$125,000,000 of supplies bought by the Commission amounted to \$30,000,000. Canada gave 18 cents per capita, New Zealand \$2.34, and Tasmania \$6.25. The American people averaged 8 cents apiece. These facts were stated in a letter issued by a group of representative mining engineers in New York in December 1916. Later the American government gave large funds for relief in Europe, but by that time Mr. Hoover was as well known as President Wilson. The 'Chronicle's' "boundless generosity", it is evident, has no rhetorical value; yet such statements depreciating Mr. Hoover's work, and making him merely the figure-head of our national response to the world tragedy, are readily accepted as authoritative, particularly when the suggestion ministers to the self-complacency of the unfortunate readers of an ignorant newspaper. Thus it has come about that one of the greatest of living Americans, in many respects the most notable figure to emerge from the stress of the Great War, is even denied the characteristic of being thoroughly American. It seems fortunate that Mr. Hoover was elected president of the American Institute of Mining and Metallurgical Engineers before the presidential campaign and before Messrs. De Young and Hearst had proved him much less American than themselves.

What the Miners Think

At the recent International (that is, Canadian and American) Mining Convention at Seattle a number of resolutions were passed, unanimously. It is interesting to note the subjects with which they were concerned. First was one endorsing the American Mining Congress for "taking the lead in maintaining proceedings against Minerals Separation, Ltd., its subsidiaries and agents, charging them with stifling and suppressing competition, monopolistic and oppressive practices and violations of the Clayton and Federal Trade Commission Acts". To the American Mining Congress were tendered "thanks for its action" and an "offer of unqualified endorsement". As our own opinions on the subject are well known, we venture to add that we had no representative in the Committee on Resolutions and had nothing whatever to do with instigating any of the resolutions passed at Seattle. The second resolution was a tribute to the public service rendered by Mr. James F. Callbreath, the secretary of the American Mining Congress. To him was tendered "this expression of our sincere appreciation of his ceaseless efforts in our behalf", and, as a concrete expression of thanks, it was recommended that "immediate steps should be taken to secure from North-West mining interests a measure of financial and moral support more commensurate with Mr. Callbreath's efforts". This resolution met with cordial, as well as unanimous, support. Next, the Convention demanded "immediate legislation

fostering the production of war minerals, in order that the United States and Canada may be industrially independent both in times of peace and in times of war". This resolution reflected the sentiment evoked by discussions on the production of magnesite, chrome, and tungsten in the North-West. The fourth resolution dealt with excess-profit and corporation taxes; it described them as "cumbersome to collect and vicious in effect, bearing inequitably and constituting a premium upon inflated capitalization, a penalty upon conservative financing, and an incentive to the withdrawal of funds from all investments but those that are tax-free"; therefore the Convention, "Canadian delegates not voting", called for "the speedy repeal of these acts and the substitution of taxation measures that will be equitable in their operation and permit of the distribution of corporation earnings upon a fair basis". The fifth, "Canadian delegates not voting" again, animadverted against the delay in awarding assistance to claimants under the War Minerals Relief Act, and condemned the "constructions and limitations now placed upon this law" by which "large numbers of worthy claimants are denied the relief intended by the law". Therefore the Convention urged "the immediate passage of legislation now before Congress to provide a more liberal administration of the War Minerals Relief Act, so that the intentions of that Act may be carried out with justice and forthwith". The next subject was the protection of American citizens in foreign countries. Reference was made to the fact that "on repeated invitations of the Mexican government prior to 1910, and since, American mining engineers, operators, and employees in large numbers have joined in the industrial development of Mexico, pursuing their professions in lawful and orderly manner, with full regard for the rights of the Mexican people, and for their obligation as American citizens to their own government", and "whereas in recent years of revolution and disorder, many American citizens in peaceful pursuit of their professions and in the guardianship of properties entrusted to their care have suffered great financial losses, personal indignities, injuries, and death", therefore the American delegates to the Convention unite in protesting "to the Department of State of the United States against further disregard of conditions in Mexico that make it unsafe" for Americans to attend to their legitimate business in Mexico. Further it was resolved "that the Government of the United States take such steps as will ensure that every American residing or having property in any foreign country shall receive the full protection of the United States government, both for himself and for his property". This resolution, we suggest, is significant, timely, and entirely commendable. The seventh resolution asserted "that the United States and Canada should be jealously reserved as the home of all who believe in our institutions and only for those who subscribe to our laws and appreciate the freedom guaranteed by our Constitutions", and that therefore "all within these borders, either foreign or of native birth, who deliberately attempt to foment industrial or social unrest should be treated as

enemies and speedily and severely be dealt with as such". The resolution then proceeds to "demand enactment of additional laws to sweep away all legal obstruction to the prompt suppression of insidious anarchy that threatens the institutions we love". This is well meant, but too sweeping. We would make a distinction between the foreigner and the native-born, allowing the latter a wider latitude in his criticism of his own Government or system of government. Besides, the resolution seems to label all strikes and other forms of protest as anarchistic, whereas most of them are not. We think this resolution ill considered and badly expressed, for it displays an illiberal spirit under the cloak of loyalty. The eighth resolution thanked Messrs. Emmet D. Boyle of Nevada, John Clausen of Seattle, E. G. Crawford of Portland, T. A. Rickard of San Francisco, and Frank A. Vanderlip of New York for their "enlightening and inspiring addresses". The ninth suggested that R. G. Dun and Bradstreets "should place mining properties and business on an equality with all other businesses, and therefore these companies are hereby requested to give ratings of mining business in the same way and for the same purpose as now done with respect to other business". We approve of this, because, among other reasons, it would give employment to several score worthy mining engineers, without whose aid no such ratings of mining ventures would be practicable. The tenth resolution recommended that as "technical questions relating to mining industry are fully covered in the technical press" and by engineering societies, therefore it would be well in future to devote the annual sessions of this Convention to questions "of commercial and legislative nature". This sets a good example to other similar conventions, especially to those of the American Mining Congress. The eleventh resolution advised "the preparation and publication of elementary works upon practical geology and mineralogy in simple language devoid of technicalities" with a view to benefiting "the prospector in the intelligent conduct of his work". This is something much to be desired, but not easily consummated, for the man that can write on scientific matters in plain English is rare indeed; the ability to do so is the supreme test of scientific knowledge and literary skill. The next subject was the gold problem. A resolution asserted that "there is no economic formula which should expect the production of gold at a loss to the producer thereof for use in the arts and industries", therefore the Convention "endorses the measure now introduced by Congressman McFadden, chairman of the House Committee of Commerce and Banking in the House of Representatives of the Congress of the United States". A resolution advocating the remonetization of silver was referred to a special committee, this being a tactful method of shelving a subject that might arouse a controversy prejudicial to the effort now being made to assist gold mining. It will be noted that the resolutions cover a wide range in economics. Undoubtedly they express the sense of a thoroughly representative convention of miners, engineers, and operators; and for that reason they are well worthy of record.

DISCUSSION



Filing of Mine Reports

The Editor:

Sir—Recent communications to your paper have suggested the timeliness of making a record of a matter which I have written about before and which has been favorably discussed, but not seriously approved of as yet.

I refer to the plan to have mining companies file, with the State Mining Bureau, accurate and complete maps concerning the underground development and conditions, so that these records may be available in the future in connection with the development of adjacent properties, or the re-opening of old mines. The record of this work is of public interest, as every engineer knows who has had occasion to examine old properties, or go into districts in which there had been earlier operations. Countless cases prove how advantageous this information would be, not only as a saver of time and experience, but as a criterion by which the value of the old property under new conditions can be easily ascertained.

Objections have been raised that this information is private property and might work to the injury of individual operators. This could easily be overcome by permitting the reports to be sealed for a definite period, only to be opened by order of court or termination of the sealed period.

This idea has been embodied in some recent legislature in Ontario and some of the States in the East have adopted the idea as a local regulation.

KIRBY THOMAS.

New York, March 28.

A Protest

The Editor:

Sir—My attention was first called to your editorial 'To Young Engineers' in your issue of April 17, 1920, by an indignant protest from a loyal Californian now residing in Arizona. The resentful feelings of a group of mining students were voiced in my office yesterday morning. I think it most unfortunate that you should, both by direct statement and implication, so scathingly condemn students of such an institution as the University of California, as unmanly, undemocratic, and unAmerican because of a time-honored custom of the upper classmen to wear 'cords'. I have heard you make the remark on many occasions that certain newspapers published in San Francisco "have a whole lot of taste—all bad". Imitation is the sincerest flattery! Even though corduroy grates on your aesthetic sense, is there any need or justification for the statement that they are 'dirty'? And what if they are, it's clean honest dirt!

The University of California has certain traditions, beloved and supported by all loyal alumni, alumnae, and students: the freshman hat, the sophomore cap, the junior 'cords', and the senior Stetson; the rallies, the pilgrimage, the serpentine, and the yells. Why brand them as provincial or denounce them ridiculous when they have survived generation after generation! Let us respect the short jacket and silk hat of Eton, the long blue coats and yellow stockings of the Blue-coat School, the crimson skull cap of Harvard, and the 'cords' of California, one is as provincial as the other maybe, but they are dear to the hearts of the student body. Then Sir, you say the wearing of distinctive dress is unAmerican, this hurts; you are treading on dangerous ground here. To emphasize your point, you, like the great Disraeli, in the exuberance of your own verbosity, maintain a more or less consistent line of argument to malign an opponent and glorify yourself. Permit me to coin a word and characterize your denouncement as being typically 'Rickardesque'. I quote from your editorial "it becomes neither a democrat nor an American to be boorish in speech".

FRANK H. PROBERT.

Dean, College of Mining,
University of California.

Berkeley, April 27.

[*De gustibus*, etc.—EDITOR.]

The Corporation and the Individual

The Editor:

Sir—Senator Hiram Johnson of California, candidate for President, has attained much of his following by his supposed opposition to corporations. Early in his career, he assailed the Southern Pacific in whirlwind style, and people applauded him. Those who knew nothing about the Southern Pacific liked to hear him attack that company. People the country over will listen to a forceful speaker who condemns the corporations. There is a strong undercurrent of resentment against corporations in general. Though J. Parke Channing and others have explained clearly that the country needs them and that, if all the wealth were divided equally, the individual would get only a small amount, still people dislike a corporation even while accepting its money as wages. What is the reason for this antagonism?

The answer lies in the manner in which corporations treat the individual. Individuals in their contact with one another give and take. A corporation gives rebuffs but never takes them; like the old-style schoolmaster, it is always right. If you disagree with it, you are wrong. It doesn't argue, it tells you. You either do things in the

corporation's way or you cease to have relations with it. Like the once-famous Kaiser, it "won't stand any nonsense". Mr. Statler, who has built up a great hotel business, tells his employees that the customer is always right. The corporation imbues its executives with the idea that the corporation is always right.

Now, a British writer said recently that what men want is power; they want to feel themselves as being in the centre of the stage. To become the cynosure of as many eyes as possible, men will struggle far into the night, will organize labor strikes, or even become ministers of the gospel. When the very human wish to express one's self and criticize things runs against the usual attitude of the corporation not to accept criticism, there come grievance and dissatisfaction. People dislike the sacrosanct 'infallibility' of corporations, which they know to be managed by men as likely to be stupid and to commit blunders as anyone else. Men holding positions of responsibility in a corporation will do, in the name of their company, things which they would hesitate to do as individuals. Normal fellows, fortified in a position with a 'big corporation', will forget their real personality and take on the corporational condescension and infallibility. Like some of the boyish officers during the War, they think that the assumption of an external thing like a uniform or a roll-top desk changes them into supermen whose word must be law.

When a corporation offers a man a position, it always regards itself as conferring a remarkable favor. Even though the salary is small and the work is drudgery, it never unbends from this top-lofty attitude. Frequently it prefers not to suggest a definite figure for a salary, for fear, apparently, that it will offer too much, but asks the fortunate one what is the least salary that he will take. This 'least salary' is then frowned upon by a succession of higher officials, who convey to the prospective employee their belief that he will not be worth such an extraordinary amount for many months, but that the philanthropic company will graciously throw the money away in the hope that later his services will prove to be a good bargain. That is, the company is willing to lose \$125 per month for a while, on the chance that afterward it will get a \$500-per-month man at \$200 per month. Business is business, of course, and corporations must make a profit somehow. If a profit can't be made at the expense of the men earning wages, because of the unrest and the unions, there is the opportunity of getting young college men to work cheaply by explaining to them the wonderful experience in which they may revel when harnessed down to the great corporation which "owns all these buildings" and whose "name is a byword in the field". Selah!

Lest it be thought that a critic who sees much hypocrisy and bluff in the way in which a corporation deals with the individual, can see no good in any corporation, it may be said that many officials remain human in spite of all efforts of the bureaucrats to inoculate them. An increasing number, perhaps, are submitting to the cant of the industrial hierarchy only to a minimum degree. The

pious 'bunk' about 'experience' and 'the necessity of low salaries so that young men will not get the swelled head' is fooling fewer people each year.

P. B. McDONALD.

New York, April 22.

The Future of Chromite in the United States

The Editor:

Sir—In your last issue there was an article on this subject by Samuel H. Dolbear, which nettled me considerably. It was stated by Mr. Dolbear that we had discovered no chromite mines in the United States which were comparable with those of New Caledonia and Rhodesia, and yet by some strange process of deduction Mr. Dolbear states that the production in the United States was more than 82,000 tons, which figure exceeds very largely the normal importation of chrome ore, which Mr. Dolbear's figures show to be less than 50,000 tons. It would seem, therefore, in spite of the fact that no mines comparable with those in New Caledonia and Rhodesia were found, nevertheless we produced more ore in the United States than was normally imported, and imports of chrome ore have come from a great many countries, including New Caledonia, Rhodesia, Cuba, Brazil, and Nicaragua.

Mr. Dolbear also states that the deposits in New Caledonia and Rhodesia are larger and purer than those in the United States. I do not know whether Mr. Dolbear has examined the Rhodesia and New Caledonia deposits or not, but I do know that there are several large high-grade deposits in California that Mr. Dolbear has not examined, including some of the properties which have been operated by me. I have talked with engineers who have been in New Caledonia, Cuba, and Brazil. I have correspondence in my office with one of the largest Rhodesian firms dealing in chrome ore, and I have also correspondence in my office from New Caledonia. From all the information I could gather from the sources mentioned, the chrome deposits in these countries are very similar to our own, and in no instance have I any definite information showing that the imported ore is any higher in quality than some of our California and Oregon ores.

As a matter of pride in our domestic production, it is astounding to read such statements which belittle our ores with such apparent lack of foundation. Mr. Dolbear's attitude is apparently against the tariff measure, notwithstanding his statement that he is a protectionist; but as one of the largest producers of chrome ore in the past, I cannot let this statement go unchallenged that our deposits in the United States are insignificant in quality and quantity as compared with the foreign ones, when to my own knowledge chrome ore has been shipped from California of very high quality, and correspondence from Rhodesia which I have, shows they have difficulty in securing high-grade chromite in that section.

C. S. MALTBY.

San Francisco, May 3.

The Bunker Hill Enterprise—IX

Inner History of the Company; Its Personnel and Its Finance

By T. A. RICKARD

In the fall of 1885 the locators of the mine commissioned James F. Wardner to obtain working capital for the erection of a mill, and he, as previously related, went to Helena, Montana, where he enlisted the interest of A. M. Holter and S. T. Hauser. The former established the A. M. Holter Hardware Co. in 1866, and it is still going. He and Hauser were active mine operators at that time and later developed the Helena & Frisco mine, near Wallace. Mr. Holter, now 89, is still living at Helena. Mr. Hauser was president of the First National Bank of Helena. They joined with A. M. Esler and W. E. Cox, both of Helena, together with D. C. Corbin of Spokane, in forming a syndicate, which accepted Wardner's proposal to concentrate 50,000 tons of ore at \$5 per ton, the concentrator to have a capacity of 100 tons per day, and to be built forthwith. This group organized the Helena Concentrating Co., with Hauser as president and Cox as secretary.* Esler was sent to the mine. At that period few men in the West knew much about designing a lead concentrator; Esler gave the job to Alfred Bradford, a flour-mill builder, and he was compelled soon to confess his metallurgical shortcomings. Thereupon Esler sent to Helena for R. K. Neill, then a millwright, now honorably prominent as the man who has recently opened up the silver bonanza of the Bush, or Premier, mine in the Salmon River district, British Columbia. Mr. Neill told me recently how he rode up Milo gulch on horseback, with his kit of tools on a packhorse. The going was bad, because there was no road, and the fallen logs across the creek made it difficult for the horses. The surrounding hills, and the gulch as well, had been swept by a forest-fire during the preceding summer.

Ground was broken for the mill on April 10, 1886; and the plant started to work on July 20. Wardner and his associates had bound themselves to have the mill at work on August 1, and they just succeeded in fulfilling this part of their contract, despite the unfavorable conditions, for everything had to be hauled from the Mission landing over a bad wagon-road. The cost of treatment was about 50 cents per ton, so the margin of operating profit was handsome. The 'joker' in the deal was that the owners of the mine were not protected by any definition of 'ore', therefore Wardner and his associates could treat material of any grade, provided the returns sufficed to pay them the \$5 per ton. The locators and their friends received no money until the smelter (at Wickes, Montana) and railroad had been paid their respective charges. Thus the

owners of the mine had the small end of the stick, and they fared badly. This forced them to give the mill people an option on the property. This option called for \$200,000; but at that time the development of the mine did not justify such a price, so they did nothing. However, they obtained a sixteenth interest in the Sullivan mine. Later, the owners gave Wardner an option, and early in 1886 he found a purchaser in Simeon G. Reed, at the rumored price of \$650,000. Mr. Reed would not buy the property until the contract with the mill people was cancelled, so, after much 'dickering', they sold out for \$100,000, for which Reed got the mill, the milling contract, and the sixteenth interest in the Sullivan mine. The sellers took options on some adjoining claims and did some prospecting, but nothing came of it. Corbin started at once to build a railroad from the Mission landing to Wardner and thereby contributed greatly not only to the development of the Bunker Hill but of the entire Coeur d'Alene region.

W. L. Lee, now living at Helena, Montana, was foreman of the mine at the time of Wardner's option. From Mr. Lee I gather that the mine was badly worked; it was being 'gouged' in the effort to maintain a large production of concentrate. Wardner had but little notion of real mining or of the true condition of the property. He ordered Lee to knock down and ship a mass of clean galena held in reserve in the Sullivan, but it was explained to him that this rich ore, and a similar 'bunch' in the Bunker Hill, was needed for 'sweetening' the output from the lean places. Although the mineral looked 'pure', it could be seen, on examination under a magnifying glass, that the cubes of galena were encased in a film of quartz, which made a difference of 8 to 10 in lead percentage between the concentrate and the lump ore. Mr. Lee says:

"The walls of the Sullivan were regular and well defined, but the Bunker Hill was broken up and more inclined to be buncchy. The walls of both mines dipped south, and the orebodies dipped west. On the Sullivan there was a mass of quartz about 40 ft. wide and over 200 ft. in length that formed the top of the main shoot or chimney of lead ore. The quartz contained no values except native crystallized silver, in wires about $\frac{1}{4}$ inch long, very bright, and pretty to look at. This silver occurred only in the seams and crevices."

When Reed visited the mine, for the purpose of inspecting it, although he also knew nothing of mining, he was astonished at the showing made by the 21 ft. of galena in the Sullivan. He exclaimed, "Well, that's better

*For these details I am indebted to Mr. Cox, who is now living at Seattle.

than I ever expected to see". This face of galena had been left intact for the purpose of helping a sale. Reed departed next day, with Wardner, and ten days later Lee received a telegram from the latter ordering him to measure the ore in the mine and on the dump, and to get his report to Spokane within three days. Shortly afterward Reed informed Lee by letter that he had bought the mine and wanted him to remain as foreman. Then came Joshua E. Clayton, with instructions also to report on the mine. After a week or more, the 'Professor' asked Lee what his estimate had been, and expressed agreement as to the tonnage. When Wardner arrived, he told Lee that he had not shown his estimate to Reed, because it was so much below the figures he himself had stated to Reed. Thereupon Lee resigned. He was asked by Reed to come to Spokane, where he told Reed the whole story, which did not seem to perturb the new owner of the mine. Reed wanted Lee to return, but he refused. By way of summary, Mr. Lee writes: "Prof. Clayton and I talked freely about the property, and he agreed with me that there was not \$150,000 in sight at that time in the property that Mr. Reed had paid \$650,000 cash for, and I firmly believe that the 21 ft. of lead ore sold the Sullivan & Bunker Hill property. Professor Clayton got \$500 for his report and I got \$20 for mine, and we both got the same results, but, best of all, the mine was there—the biggest silver-lead property in the world."

The Bunker Hill & Sullivan Mining & Concentrating Company was incorporated under the laws of Oregon, at Portland, on July 29, 1887, by S. G. Reed, his secretary (Martin Winch), and N. S. Kellogg. The capitalization was \$3,000,000 in 300,000 shares of \$10 each. Of these 250,000 were issued. Information concerning the amount of money paid for the various mining claims acquired by the company at the start is not now available, because the old records were kept in the office at Kellogg and were destroyed when the building was dynamited in 1899; other records of the company were burnt in the San Francisco earthquake-fire of 1906. Out of the 250,000 shares issued, 249,998 went to S. G. Reed, and one share apiece went to Martin Winch and N. S. Kellogg. On October 3, however, Kellogg received 33,872 shares from Reed's allotment. He sold out on March 31, 1890. Sullivan received 1694 shares from Reed on November 7, 1887, but he disposed of them all before December 18, 1891. O'Rourke received 6774 shares on April 27, 1888, and sold them prior to January 11, 1894. Thus all the discoverers ceased to be shareholders within seven years.

'Sim' Reed, as he was generally known, was a good specimen of the business man of the frontier days. He was a native of Massachusetts and came to San Francisco, by way of Panama, in 1852, when he was 22 years old. He was a clerk and then a partner in the firm of W. S. Ladd & Co. In 1858 he became active in the development of the steamship business and founded the Oregon Steam Navigation Company in 1860. His connection with this enterprise, as director and vice-president, lasted until the transfer of the property to the Villard Syndicate for \$5,000,000 in 1879. In the same year he participated with A. Onderdonk and D. O. Mills

in a contract for building the first section of the Canadian Pacific Railway, from Port Moody to Kamloops, in British Columbia. In 1882 he organized the Oregon Iron & Steel Co. and erected a plant to make pig-iron and cast-iron pipe, in which respect this plant was a pioneer on the Pacific Coast. He was regarded as a man of sagacious and enterprising character, with the courage to face and overcome difficulties. He owned the Abington building, the largest office-building in the city of Portland, and he is said to have mortgaged this property in order to raise the money needed to purchase the Bunker Hill and Sullivan mines. He sold his shares in the Bunker Hill company because bad health prevented him from devoting his personal attention to the management. Having made the sale, he went to Europe for a holiday. In 1904 he gave \$3,000,000 to found the Reed Institute, at Portland. This college is a monument to his intelligence and generosity. He died at Pasadena, California, on November 7, 1905.

Shortly after purchasing the mine, Reed asked W. B. Bourn, of San Francisco, to recommend a superintendent, and Mr. Bourn recommended Victor Clement, formerly of Los Angeles, a graduate from the Santa Clara college, and at that time in charge of the Empire mine at Grass Valley, California. He was appointed manager on August 1, 1887, with a salary of \$500 per month and expenses. In July 1891 this salary was increased to \$10,000 per annum. Clement proceeded to Wardner and soon advised Reed that money would be needed to build a tramway, as well as a concentrator of better design and larger capacity than the mill that had been erected at the mouth of the Small Hopes tunnel, in Milo gulch.

The new mill was built at Kellogg in 1891. It was connected with the mines by a Bleichert tramway, erected in the same year by the Trenton Iron Works and re-constructed by them in 1892. This tramway had a horizontal length of 10,000 ft. and cost, in all, \$92,635. "It proved a troublesome affair. The nominal capacity was 400 tons per day. At the beginning the cost of carrying ore over the tramway was greater than if it had been done by horse and wagon. Owing to defects in design and erection there were frequent accidents, which not only interrupted the delivery of ore to the mill and consequently increased the operating cost, but the dropping of buckets upon the town of Wardner caused endless difficulties. One span, 1400 ft. long, passed over the town. Buckets dropped from the line, so that persons in their homes and horses in the street were killed. A new type of button was put on the moving rope, the brake station in the town was cut out, and one long span substituted, thereby diminishing the liability to accident; at the same time the number of buckets was increased and the tramway was worked over-time, so that its average capacity was increased to 520 tons per day before its use was superseded by an adit."

The records show that although 213,108 tons of ore was mined up to May 31, 1892, for which the smelter made returns of \$1,923,083, yielding an operating profit of \$899,601, the company was unable to accumulate sufficient money to provide the plant and equipment neces-

STATISTICAL SUMMARY OF THE OPERATION OF THE BUNKER HILL & SULLIVAN MINING & CONCENTRATING COMPANY

COST PER TON MINED

From 1886 to 1919

Year	Tons mined	Stopping	Tramming	Concentration	Shipping	Superintendence, etc.	Legal and extraordinary	Contingent	Total
May 1886 to July 1887....	26,855	.....	.....	.....	.....	.....	.....	.....	.....
Aug. 1887 " Dec. 1888....	79,263	.....	.....	.....	.....	.....	.....	.....	\$3,953
June 1888 " May 1889....	37,784	.....	.....	.....	.....	.....	.....	.....	4,236
" 1889 " " 1890....	No ore mined or treated								
" 1890 " " 1891....	17,092	.....	.....	.....	.....	.....	.....	.....	2,408
" 1891 " " 1892....	52,114	\$2.673	\$0.290	\$0.430	.....	\$0.500	.....	.....	3,893
" 1892 " " 1893....	105,287	2.820	0.164	0.508	\$0.062	0.148	\$0.025	\$0.333	4,060
" 1893 " " 1894....	99,657	2.094	0.119	0.464	0.061	0.170	0.045	0.060	3,013
" 1894 " " 1895....	71,084	2.025	0.113	0.365	0.050	0.124	0.028	0.028	2,733
" 1895 " " 1896....	142,976	1.984	0.085	0.299	0.030	0.115	0.028	0.082	2,623
" 1896 " " 1897....	171,359	2.295	0.089	0.254	0.028	0.100	0.021	0.101	2,888
" 1897 " " 1898....	187,243	2.039	0.099	0.228	0.029	0.100	0.007	0.012	2,514
" 1898 " " 1899....	178,568	2.265	0.083	0.259	0.029	0.110	0.017	0.133	2,896
" 1899 " " 1900....	160,035	2.677	0.105	0.305	0.047	0.138	0.029	0.170	3,472
" 1900 " " 1901....	227,308	2.386	0.098	0.227	0.026	0.098	0.021	0.049	2,905
" 1901 " " 1902....	281,590	2.068	0.100	0.197	0.024	0.081	0.015	0.051	2,536
" 1902 " " 1903....	260,500	2.101	0.095	0.237	0.027	0.094	0.016	0.063	2,633
" 1903 " " 1904....	285,357	1.563	0.070	0.201	0.027	0.084	0.020	0.011	1,976
" 1904 " " 1905....	320,056	1.385	0.063	0.180	0.043	0.078	0.009	0.057	1,815
" 1905 " " 1906....	347,350	1.286	0.060	0.185	0.049	0.074	0.009	0.083	1,746
" 1906 " " 1907....	336,630	1.470	0.069	0.244	0.051	0.084	0.009	0.050	1,977
" 1907 " " 1908....	335,070	1.551	0.082	0.367	0.046	0.086	0.009	0.040	2,181
" 1908 " " 1909....	344,470	1.563	0.083	0.382	0.047	0.086	0.008	0.041	2,210
" 1909 " " 1910....	377,530	1.450	0.069	0.408	0.046	0.078	0.008	0.031	2,090
" 1910 " " 1911....	438,290	1.423	0.067	0.380	0.038	0.073	0.007	0.048	2,036
" 1911 " Dec. 1912....	702,520	1.602	0.074	0.374	0.034	0.073	0.007	0.086	2,250
1913.....	436,060	1.634	0.067	0.458	0.020	0.275	0.255	0.061	2,770
1914.....	440,819	1.704	0.056	0.376	0.007	0.185	0.072	0.038	2,438
1915.....	455,205	1.807	0.056	0.406	0.019	0.118	0.032	0.050	2,488
1916.....	475,784	2.081	0.059	0.572	0.022	0.144	0.063	0.064	3,005
1917.....	493,030	2.066	0.058	0.581	0.030	0.176	0.062	0.060	3,033
1918.....	389,027	2.324	0.078	0.662	0.039	0.333	0.204	0.012	3,702
1919.....	393,698	2.580	0.078	0.814	0.063	0.573	0.015	0.125	4,248
Total.....	8,669,611								

HISTORICAL SUMMARY OF OPERATIONS

Year	Total tons mined	A Total gross value recovered per ton	A - B Difference per ton	B Net smelter returns per ton	B - C Difference per ton	C Operating profit per ton	D Profit from other sources per ton	E Dividends per ton
May 1886 to July 1887...	26,855	\$23,740	\$12,651	\$11,089	.....	.....	.....	.....
Aug. 1887 " Dec. 1888....	79,263	20,878	11,137	9,741	\$3,953	\$5,788	.....	.....
June 1888 " May 1889....	37,784	19,451	10,664	8,787	4,236	4,551	.....	.....
" 1889 " " 1890....	No ore mined or treated							
" 1890 " " 1891....	17,092	9,273	4,771	4,502	2,408	2,094	.....	.....
" 1891 " " 1892....	52,114	14,702	6,371	8,331	3,860	4,471	.....	.....
" 1892 " " 1893....	105,287	11,645	5,151	6,494	4,060	2,434	.....	.....
" 1893 " " 1894....	99,657	11,623	5,740	5,883	3,013	2,870	.....	\$0.602
" 1894 " " 1895....	71,084	7,913	4,150	3,763	2,734	1,029	.....	0.211
" 1895 " " 1896....	142,976	6,275	2,530	3,745	2,623	1,122	.....	0.251
" 1896 " " 1897....	171,359	6,553	2,672	3,881	2,887	0,994	.....	0.052
" 1897 " " 1898....	187,243	8,368	3,321	5,047	2,514	2,533	.....	0.977
" 1898 " " 1899....	178,568	8,507	3,371	5,136	2,897	2,239	\$0.152	1,377
" 1899 " " 1900....	160,035	11,639	4,330	7,309	3,472	3,837	0.106	1,255
" 1900 " " 1901....	227,308	7,318	3,012	4,306	2,906	1,400	0.101	1,108
" 1901 " " 1902....	281,590	6,448	2,714	3,734	2,535	1,199	0.065	0,852
" 1902 " " 1903....	260,500	6,231	2,785	3,446	2,634	0,812	0.123	0,172
" 1903 " " 1904....	285,357	6,885	2,814	4,071	1,999	2,072	0.126	1,082
" 1904 " " 1905....	320,056	11,383	4,891	6,492	1,815	4,677	0.570	3,749
" 1905 " " 1906....	347,350	13,774	5,190	8,584	1,746	6,838	4,218	10,013
" 1906 " " 1907....	336,630	14,888	5,106	9,782	1,976	7,806	0.170	6,951
" 1907 " " 1908....	335,070	10,121	4,034	6,087	2,182	3,905	0.080	4,118
" 1908 " " 1909....	344,470	9,289	3,899	5,390	2,210	3,180	0.089	2,394
" 1909 " " 1910....	377,530	8,761	3,492	5,269	2,089	3,180	0.112	1,769
" 1910 " " 1911....	438,290	7,546	2,865	4,681	2,148	2,533	0.079	2,424
" 1911 " Dec. 1912....	702,520	7,682	2,819	4,863	2,389	2,474	0.115	1,722
1913.....	436,060	8,921	3,578	5,343	2,775	2,568	0.271	1,874
1914.....	440,819	7,627	3,077	4,550	2,395	2,155	0.363	2,225
1915.....	455,205	9,178	3,940	5,238	2,460	2,778	1,326	2,334
1916.....	475,784	13,143	6,212	6,931	3,005	3,926	1,094	3,608
1917.....	493,030	19,441	9,414	10,027	3,312	6,715	0,487	4,145
1918.....	389,027	15,665	5,515	10,150	3,695	6,455	0,995	3,993
Total tons mined and averages per ton.....	8,275,913	\$10,432	\$4,343	6,089	2,613	3,476	0,496	2,668
Percentages of A.....		A	41.6	58.3	25.0	33.3	.....	25.5

sary for its expanding operations. In September 1890 Reed made a deal with John Hays Hammond whereby the latter, in consideration of a commission of 2500 shares of the company's stock, agreed to find \$300,000 of working capital. On October 2 Mr. Hammond obtained \$150,000 from D. O. Mills, as a loan at 10% on 50,000 shares, with an option to buy them at \$3 per share. This option Mr. Mills exercised on June 17, 1891. Mr. Hammond sold another block of 50,000 shares at \$3 to a Chicago syndicate headed by James H. Houghteling, of Peabody, Houghteling & Co. This money was needed to make the improvements recommended in a report by H. H. Webb, including the Bleichert tramway and the new mill. Early in January of the following year (1891) the secretary's report showed a deficit of \$130,000 and stated that the new concentrating plant at Kellogg would not start work until April, at which time a profit of \$60,000 per month was anticipated. A loan of \$60,000 was made by the First National Bank of Portland, this debt being reduced to \$35,000 by July. A little later, in consequence of the company's purchase of a number of additional mining claims, its indebtedness to the Portland bank increased to a point where it became embarrassing. Thereupon, on September 18, 1891, W. H. Crocker of San Francisco loaned the company \$110,000 at 1% per month, and a week later he became a director. Mr. Crocker's bank became the depository of the company's funds; he has been a member of the executive committee and treasurer of the company ever since, in which capacity he has loyally served it through its every financial necessity. On May 31, 1892, the Bunker Hill company's balance-sheet showed assets of \$3,483,277, with liabilities, in the form of money due, amounting to \$167,000. In September of that year Mr. Mills again stepped into the breach by loaning \$50,000 at 10% to apply on the indebtedness. At about the same time General N. H. Harris, uncle-in-law of Mr. Hammond, lent the company \$20,000 at 10%, for the purchase of the 'Lackawanna' claim. In May 1893 the net assets had risen to \$3,657,554 and the cash liabilities had decreased to \$63,000.

Many transfers of stock were made during these years. Mr. Hammond obtained his first holding as a commission, as we have seen; prior to September 21, 1892, he owned 32,962 shares. He now owns 15,001, and Mrs. Hammond holds 3499, plus the 500 which she inherited from the estate of her uncle, General Harris. Mr. Hammond obtained 1220 from Reed, 9796 from Kellogg, 625 from Mills, 15,858 from Crocker, 500 from Forbes-Leith, 500 from C. L. Hutchinson, and 5000 in the Chicago syndicate sale. Victor Clement acquired 36,301 shares, which he held to the time of his death. He obtained 12,979 from Reed, 4075 from Hammond, 16,051 from Kellogg, 625 from Mills, and 2571 from Mrs. W. H. Crocker.

The shares acquired by Hammond and Clement from Kellogg formed part of Kellogg's original holding of 33,873 shares, which Clement contracted to purchase on March 31, 1890, and two-fifths of which he assigned to George Crocker. Under the terms of this purchase the shares would have cost about \$2.21 apiece. A sum equal to 74 cents per share was paid to Kellogg at the time, the balance being payable two years later, with interest at 5%. One cannot but note that Kellogg got 5% on his deferred money, whereas money at the time commanded as much as 1% per month. During the interval, before the Kellogg deal was consummated, Clement was free to vote Kellogg's stock and received the dividends paid upon it, but he was under obligation to pay any assessments that might be levied. The remainder of Kellogg's stock, 8026 shares, was not taken up by George Crocker, but by another member of the Crocker family. In January 1894 Mills acquired 5349 of O'Rourke's shares. Cyrus H. McCormick, of the American Harvester Company, became a shareholder in February 1891; he still holds 19,500 shares. Simeon Reed sold his last shares on June 2, 1893. They are worth now \$50 apiece.

The accompanying tabulation records the names of the successive presidents, managers, and assistant-managers, with the time of their service. On July 2, 1891, Reed was succeeded as president by Hammond, who was placed on the salary list at \$500 per month on July 30, 1892, or

LISTS OF PRESIDENTS, MANAGERS, AND ASSISTANT-MANAGERS

According to Official Records

				Presidents	Managers	Assistant-Managers
July	29, 1887, to	July	2, 1891	S. G. Reed	.....	.....
August	1, 1887, "	March	20, 1893	.....	V. M. Clement	.....
October	1, 1890, "	March	20, 1893	.....	.....	F. W. Bradley
July	2, 1891, "	June	15, 1893	J. H. Hammond	.....	.....
March	20, 1893, "	June	1, 1901	.....	F. W. Bradley	.....
June	15, 1893, "	June	17, 1897	N. H. Harris	.....	.....
May	15, 1897, "	June	1, 1901	.....	.....	A. Burch
June	17, 1897, "	date		F. W. Bradley	.....	.....
June	1, 1901, "	June	16, 1904*	.....	A. Burch	.....
June	23, 1903,†	June	16, 1904	.....	.....	S. A. Easton
June	16, 1904, "	date		.....	S. A. Easton	.....

*Burch ceased to be Manager (Easton taking his place as such) on January 1, 1903, but, according to the records, Burch did not relinquish title until June 16, 1904.

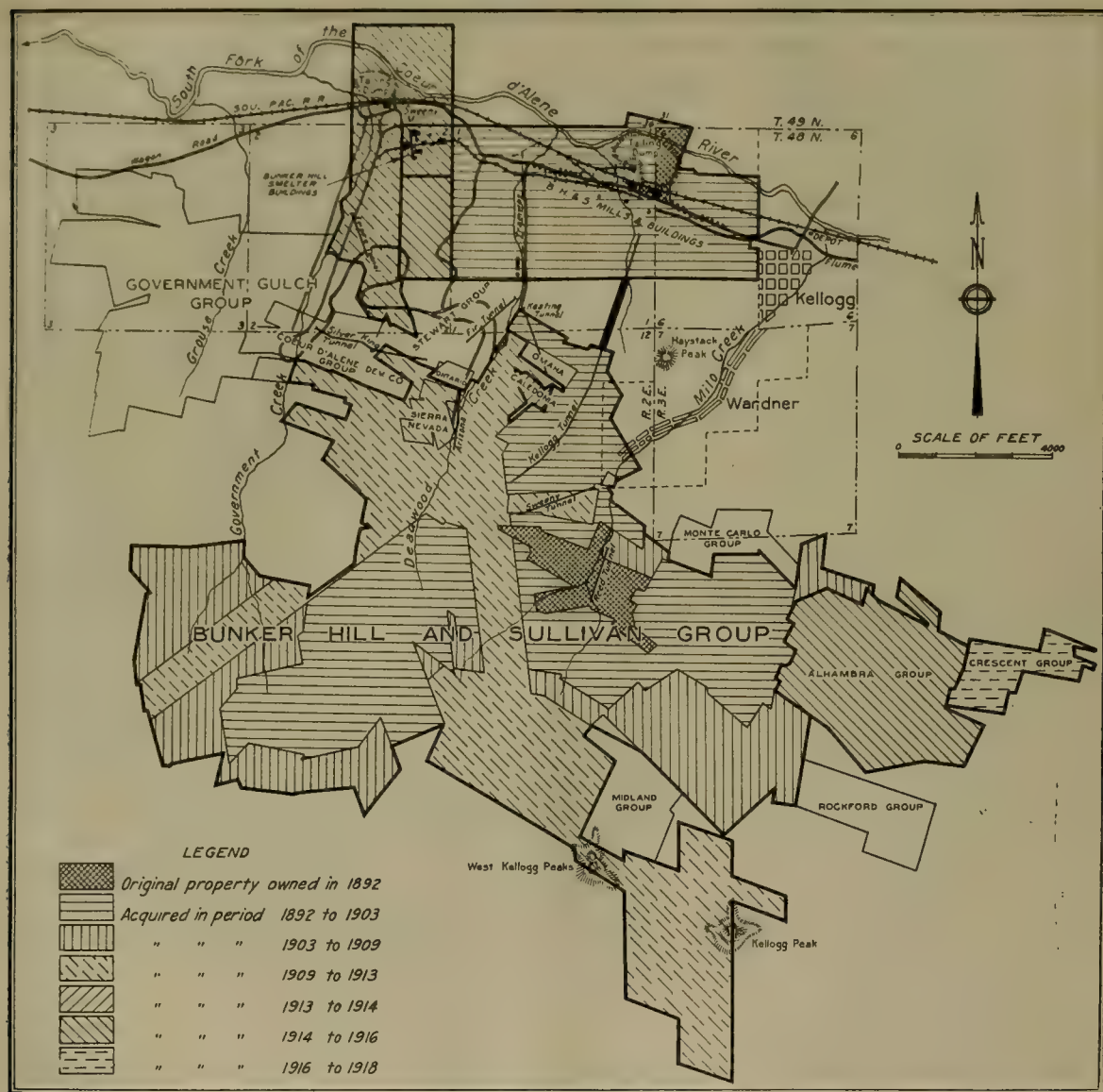
†According to the records, Easton was appointed Assistant-Manager on June 23, 1903, but began his connection as such in July 1902.

F. Burbidge served as Acting Manager from July 1897 to June 1, 1901.

thirteen months after his election to the presidency of the company. He left the United States for South Africa in 1893, and was succeeded by General Harris on June 15 of that year. The General retired four years later in favor of Frederick W. Bradley, who has continued in office ever since. Mr. Bradley had been appointed as-

able of American mine operators. In 1897 I met Clement at Kalgoorlie, in Western Australia. He was a most capable engineer and a man of sterling character. He died at Saltillo, in Mexico, on April 26, 1903.

H. H. Webb was assistant to Clement in 1889. C. R. Corning was consulting engineer to the company for



MAP OF THE BUNKER HILL PROPERTY

sistant-manager in 1890 and manager in 1893, so that he was manager and president concurrently for four years. He has been an officer of the company for 30 years. The first manager, Victor Clement, left the mine to go to South Africa with Mr. Hammond in 1893, after having been manager for nearly six years. He became manager of the Simmer & Jack mine at Johannesburg and returned to the United States in 1896, becoming associated with the late Capt. J. R. De Lamar, one of the most not-

three years from 1893. Albert Burch was appointed assistant-manager in 1897 and was promoted to manager in 1901. After that he served as consulting engineer until June 1906. Stanly A. Easton followed Mr. Burch as assistant-manager in July 1902 and became manager on January 1, 1903. He has been manager continuously since then, a period of 17 years.

We have seen that in 1892 the Bunker Hill enterprise was not looking cheerful; the operating profit was about

\$250,000 per year, it is true, but this revenue was insufficient to provide for the necessary improvements, as well as pay for the additional mining claims that had to be purchased. In the fall of 1892 Hammond wrote to Clement suggesting that they had better get out and take advantage of the boom in South African mining, because he anticipated that the earnings of the Bunker Hill would all be absorbed by the changes to be made in the existing plant and in the purchase of additional equipment. So he sent Ernest Wiltsee to London as an advance agent and shortly thereafter accepted a retainer from Barney Barnato. When Hammond and Clement left, the Bunker Hill was heavily in debt and it had less ore in reserve than at any time since. Soon after their departure the silver panic of 1893 prevented the shipment of ore to the smelter. Those were dark days; but they were the darkness before the dawn. In June 1894 the company owed only \$9571. In that year the first dividend was paid. Between 1894 and 1900 the net assets of the company rose to \$4,436,993 and it paid \$750,000 in dividends, besides having a cash reserve of \$266,283.

The Kellogg tunnel was started in 1897 and reached the vein in 1901, but it did not cut the main Bunker Hill ore-shoot until 1904. The cost of driving this adit had to be met out of current earnings, while the right to extend it was contested bitterly by a neighboring company, which eventually forced the Bunker Hill company to divert the course of the adit around certain property lines. The completion of this work not only afforded cheaper facilities for moving ore from the mine to the mill but permitted a large increase in the tonnage mined and milled, thereby diminishing the cost per ton; indeed, it is not too much to say that if the adit had not been driven at the time it was and if it had not cut a big swell of ore where it intersected the main Bunker Hill ore-shoot, there would have supervened then as close a shave for the continuity of profitable operations as the enterprise experienced when the mine, plant, and offices were dynamited in 1899. Of these happenings, and of the strike in 1892, I shall speak in a separate article.

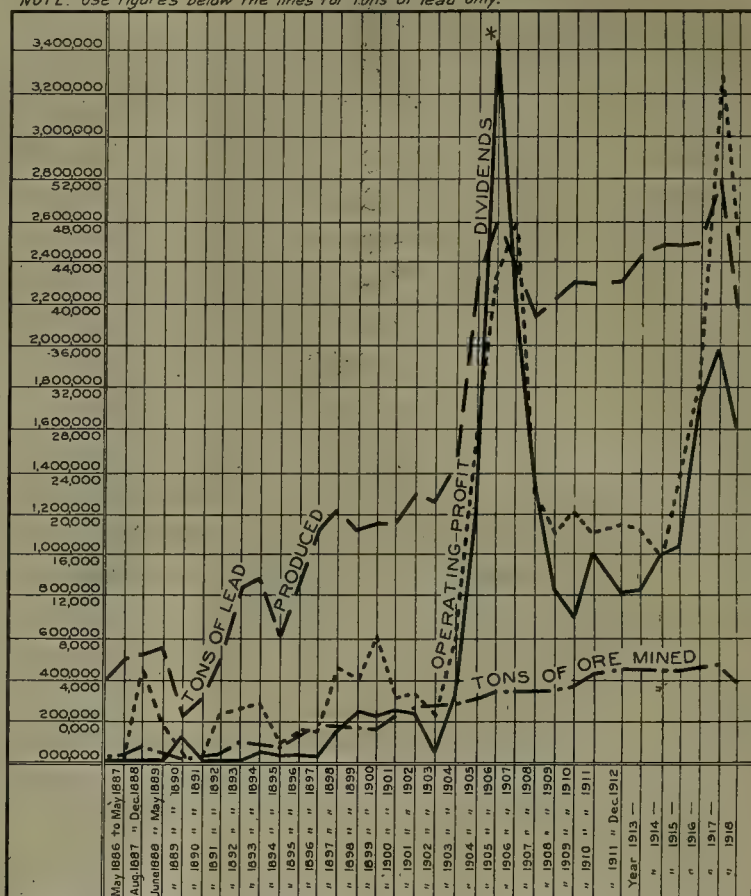
The story of general economics is told by the following figures, giving the total working cost:

	Per ton
January 1902.....	\$2.57
" 1903.....	2.61
" 1904.....	2.00
" 1905.....	1.68
June 1905.....	1.40

However, the reduction in working cost was not the sole factor in establishing the prosperity of the mine, as the accompanying graph, recording the economic history of the enterprise, will show. In 1888 the cost was \$3.95 and in 1889 it was \$4.23 per ton. We have seen how it fell to \$1.40 in June 1905; after that it rose steadily, thus:

Year ending May	1906.....	\$1.746
" " "	1907.....	1.977

NOTE. Use figures below the lines for tons of lead only.



* Excess of Dividends over operating profit due to disbursement of receipts from sale of Tacoma Smelter Company Stock.

GRAPHIC RECORD OF ECONOMIC HISTORY

" " "	1908.....	2.181
" " "	1909.....	2.210
" " "	1910.....	2.090
" " "	1911.....	2.036
" " December	1912.....	2.250
" " "	1913.....	2.770
" " "	1914.....	2.438
" " "	1915.....	2.488
" " "	1916.....	3.033
" " "	1917.....	3.312
" " "	1918.....	3.702

The average for 32 years has been \$2.546 per ton. It will be noted that the War brought its burdens, for during the period 1915-1918 the cost averaged \$3.07, or 72

cents more per ton than in the preceding four years. The service of the Kellogg tunnel was the chief cause, as we have seen, in reducing the operating cost up to 1905; when this adit was completed the mill was supplied for a time from one or more large stopes directly at the end of the tunnel; since then the cost has increased because the ore has had to be collected from many different and scattered stopes, and then hoisted or lowered to the adit, according to its source, before being trammed to the mill. This factor has been of persistently increasing importance, and the effect of it has been, as the records show, to augment the cost from \$1.746 per ton in 1906 to \$2.438 in 1914, an increase of 69 cents per ton. Since then higher wages, shorter hours, greater cost of machinery and supplies, and of rail transportation, have been unfavorable factors, culminating in 1918, in which year the average operating cost per ton was the highest incurred since 1893.

In 1902, after Hammond and Clement had returned from South Africa, they endeavored to promote a sale of the Bunker Hill to the Guggenheims at \$10 per share. They themselves were willing to take \$8 for their stock, and after Clement's death in 1903 Mrs. Clement, knowing his views as to the value of the stock, gave an option to Mr. Bradley on her 36,301 shares at \$8 per share. Mr. Bradley gave the principal shareholders a chance to buy this holding, but neither he nor his friends took any action in the matter. Up to that time the total dividends had only amounted to \$4.20 per share. Shortly afterward the March orebody was opened up and the sale of the Tacoma smelter in 1905 yielded an extra dividend of \$5 per share, just prior to the payment of which, Daniel Guggenheim and brothers bought Mrs. Clement's stock at \$25 per share, making for her a total of \$907,525. Let us call it a million to make it romantic, for, it did indeed punctuate a romantic story. Flora Smith was a girl of 16 when she and her sister arrived in the gold-mining camp of Murray in 1885. Adam Aulbach tells me that Miss Smith was the belle of that frontier community, and those who have known either Mrs. Clement or Mrs. Cloman will not hesitate to believe it. Later she went to Miss Lake's school in San Francisco for two years. In 1891 she married Victor Clement at Portland and they then returned to Wardner on the eve of the big strike in the Coeur d'Alene. She shared that trying experience with her husband and she also shared his interesting experiences in South Africa, Utah, and Mexico. Four years after his death, she married Capt. Sidney Cloman of the U. S. Army, who in 1906 was military attaché at the American legation in London. There she and her gallant husband made many friends. Capt. Cloman had retired from service when the United States declared war against Germany, but he volunteered immediately and served in France with such distinction as to win the Distinguished Service Medal and the Croix de Guerre. They are now living at Burlingame, near San Francisco. Mr. Guggenheim bought Mrs. Cloman's shares, to their mutual benefit. Since 1902 dividends totaling \$74 per share have been paid on the original 300,000 shares, and, in addition, the enterprise out of its

own earnings has paid for the Kellogg adit, several mills, and other plants, including a \$3,000,000 smelter. On December 31, 1919, the mine had 5,116,938 tons of ore blocked out, and the company had \$2,383,933 in hand in cash and bonds.

(To be continued)

Peruvian Copper & Smelting Co.

Considerable interest has been aroused in Peru by the recent construction and development work of the Peruvian Copper & Smelting Co., which has a \$10,000,000 authorized capital. The stock has not been offered to the public or listed on any exchange. The money thus far has been provided by syndicate financing.

Last year the company acquired extensive copper properties at Yauricocha and Felicidad, 50 miles from Pachacayo station on the Central Railroad of Peru; also several square miles of coal-lands in the heart of the Jatunhuasi district, 30 miles from Pachacayo. This is the most important coal-fields in Peru and the engineers report that on the company's property is a deposit of 40,000,000 tons of good bituminous coal and that numerous samples taken along continuous veins for a distance of over three miles all produce excellent coke for smelting operations.

At Yauricocha, the company's copper mines have been partly developed by two main shafts each over 200 ft. deep, numerous drifts and tunnels revealing a large body of ore averaging 12% copper and considerable silver. The company's undeveloped property at Felicidad, seven miles from Yauricocha, is overlapped by the largest gossan outcrop thus far discovered in Peru, similar in character to that found at Cerro de Pasco and according to engineers familiar with both properties, likely to show a copper ore deposit fully as extensive.

The Peruvian Copper & Smelting Co. is now engaged in timbering double-compartment shafts at Yauricocha, extending its underground workings to connect its principal shafts preliminary to production, and erecting blast-furnaces and reverberatory smelters and a hydro-electric plant, most of which equipment has already been delivered. Also a contract has been let for the construction of a battery of coke-ovens at the company's Jatunhuasi coal mines and the building of a road, employing several hundred native laborers, is being rapidly pushed from the Central Railroad of Peru at Pachacayo to Jatunhuasi coal-fields and Yauricocha smelter and copper mines.

This road will give a down-grade haul of 30 miles from the Jatunhuasi coal mines and coke-ovens at 15,000 ft. elevation to Pachacayo station at 11,630 ft. and a down-grade haul of 16 miles from the company's coal mines and coke-ovens to its smelters at 13,225 ft. elevation near Yauricocha copper mines. This comparatively short haul of coal and coke to smelter and the location of the latter in the immediate vicinity of the copper mines, thus minimizing ore transportation, gives the company in connection with exceptionally high-grade 12% copper ore, an opportunity for low cost production.

Proceedings Against Minerals Separation Before the Federal Trade Commission

The hearings in the Federal Trade Commission's proceeding against Minerals Separation, Ltd., Minerals Separation North American Corporation, Beer, Sondheimer & Co., and other respondents, whom the Commission has charged with suppressing competition by an oppressive system of license agreements with mining companies throughout the United States, commenced in New York on April 7 and continued to April 16, when they were adjourned.

John Ballot, the first witness, testified that he is a British subject residing in the United States, and has been connected with the various Minerals Separation companies from the beginning. Mr. Ballot is chairman of the three British Minerals Separation companies and is president of the Minerals Separation North American Corporation.

Minerals Separation, Ltd., the parent company, was organized in London in 1903 for the purpose of developing processes of ore concentration. This was two years prior to the discovery of the flotation process in the laboratories of Sulman, Picard, and Ballot. In 1910, it was decided to exploit the patents obtained for this process in the United States and accordingly Minerals Separation American Syndicate, Ltd., was organized in London with a capital of £52,500. This corporation acquired the American rights to flotation patents, and worked in conjunction with Beer, Sondheimer & Co., who became its American agents in 1911.

Beer, Sondheimer & Co. was a German firm, with its principal office at Frankfort, Germany, and one of the Sondheimers was a director in the American syndicate. The German firm was also one of the three stockholders of the American syndicate, Minerals Separation, Ltd., and Lazard Brothers of London being the other two. Benno Elkan and Otto Frohnknecht were the local representatives of Beer, Sondheimer & Co. in New York.

In 1913, the need for additional capital was felt in connection with the American venture, and accordingly Minerals Separation American Syndicate (1913) Ltd. was organized with a capital of £250,000, taking over all the business of the first American syndicate. At the outbreak of war, Beer, Sondheimer & Co. of Frankfort owned 32,165 shares in this (1913) syndicate. Its principal stockholders, in September 1916, were Beer, Sondheimer & Co. of Frankfort, Elkan and Frohnknecht of Beer, Sondheimer & Co.'s New York office, Lazard Brothers of London, and the parent company. By that time, the Public Trustee of Great Britain had intervened and seized the stock interest of Beer, Sondheimer & Co. of Frankfort.

At the outbreak of the War, Minerals Separation American Syndicate (1913) Ltd. found itself a British company represented in the United States by Beer, Sond-

heimer & Co., an enemy German firm. Eminent English counsel, Sir Frederick Smith, now Lord Chancellor of England, advised that continuance of any agency relations with the New York representatives of Beer, Sondheimer & Co. was very dubious, but the problem was taken up with British authorities in connection with the Trading with the Enemy Act, and after the agency agreement with Beer, Sondheimer & Co. had been changed in several respects in deference to British regulations, exclusive agency relations with Elkan and Frohnknecht, the New York representatives of Beer, Sondheimer & Co., were continued until the latter part of 1916. Later, in 1916, 17,500 shares of (1913) Syndicate stock were issued to Elkan and Frohnknecht in commutation of their exclusive agency commissions past and future.

In 1916, for the purpose of obtaining the advantages of an American status, it was deemed advisable to have the American business conducted by an American corporation, and to this end Minerals Separation North American Corporation was incorporated on December 7, 1916, under the laws of Maryland. The new corporation rented part of Beer, Sondheimer & Co.'s offices at 61 Broadway, New York, and acquired all the American rights and took over all the Minerals Separation business heretofore transacted by Beer, Sondheimer & Co. and the American syndicates. Part of the arrangement was that Elkan and Frohnknecht should acquire 35,000 voting-trust certificates in the new company, and become its general agents, which voting-trust certificates and all dividends thereon should be held for their benefit by Guaranty Trust Company of New York, and delivered over to them only after the close of the War. Elkan and Frohnknecht, meanwhile, had taken steps to become American citizens. This arrangement regarding Elkan and Frohnknecht's voting-trust certificates was upset, however, when the Alien Property Custodian, in Washington, after prolonged investigation, seized these certificates on the ground that Elkan and Frohnknecht had acquired them actually in behalf of Beer, Sondheimer & Co. of Frankfort. The Alien Property Custodian also seized 65,230 more voting-trust certificates, representing the interest of Beer, Sondheimer & Co. of Frankfort through the latter's ownership of 32,615 shares in the (1913) American syndicate, so that over 100,000 voting-trust certificates have now been taken over by the Alien Property Custodian as having been German-controlled.

The schedule of royalty rates put out by Minerals Separation North American Corporation was introduced in evidence. It showed four methods for computing royalties: percentage, unitage, tonnage, and a flat rate. Great stress was laid by Mr. Ballot upon the fact that the licensee was permitted to choose any of these methods that might suit him, but Dr. Gregory later testified that

as a matter of fact all these royalty rates worked out practically to the same result. Out of every dollar's worth saved, Dr. Gregory testified, "We ought to get something in the neighborhood of, say, ten cents to satisfy our own end, and we framed our royalty to suit that". "All those various schedules really amount to that."

Mr. Ballot estimated that there were 120 licensees under the Minerals Separation patents treating about 28,000,000 tons of ore annually, and about 500 infringers treating about 40,000,000 tons of ore annually. During the War, according to Mr. Ballot, Minerals Separation refrained from prosecuting infringers in order to permit the greatest possible production of metal for America and her Allies. Now, however, the Minerals Separation policy is to settle with infringers upon payment of double the usual royalties during the period of infringement and then to issue a license at regular rates. "If I am an infringer, and want to atone for my past misdeeds, and agree to pay double the amount of this schedule which may be collected, I am shriven for my past misdeeds, and have the right to take a license." "And if I don't want to take a license, you (Minerals Separation North American Corporation) will shrive me for my past deeds, and let me go my way, whether I take a license or not," is the way counsel for Minerals Separation North American Corporation expressed it.

Although Minerals Separation North American Corporation, in its formal answer to the Federal Trade Commission's complaint, declared that only two exceptions had ever been made to its standard form of license agreement, Mr. Ballot admitted that at least 11 large companies were working under license agreements which differed from the standard form. Inquiry by the Federal Trade Commission's counsel also elicited the information that there were three other special license agreements and that a rebate of one-half the prescribed royalty had been made to another large company.

The financial condition of Minerals Separation North American Corporation proved to be delicate ground, and inquiry concerning it by the Federal Trade Commission's counsel aroused strenuous opposition on the part of the Corporation's counsel. Mr. Ballot was asked to tell the corporation's gross income, but after a heated argument was directed by his counsel not to answer, and accordingly he refused to do so. He likewise refused to state the book-value of the corporation's stock or to answer any other question touching on income, dividends, surplus, or profits, although demanded to answer by the examiner of the Federal Trade Commission conducting the investigation.

Dr. Gregory testified that he is a British subject, born in Persia, and residing in the United States, and has been connected with the Minerals Separation companies since the start. He is resident managing director of the British companies, and is now vice-president of the North American Corporation. Dr. Gregory was anxious to explain the provisions of the Minerals Separation license agreement, which he declared had been unjustly criti-

cized. "Our contract," Dr. Gregory testified, "is designed to prevent, if I may use the word, crooks from over-reaching themselves, but with the honest man our contract has absolutely no fears." To the objection that their contract never terminates, Dr. Gregory replied that it "terminates upon their ceasing to use the flotation process, and it commences again when they start to use it." Referring to the clause of the Minerals Separation contract relating to the use of apparatus not covered by Minerals Separation patents, Dr. Gregory stated that "as a protection to ourselves we put in this clause", "that when you are going to use our process you must use our apparatus". The clause regarding the acquisition of inventions made by Minerals Separation licensees was inserted, Dr. Gregory testified, because "we wanted to make ourselves a sort of exchange whereby all our clients would get the benefit of the inventions mutually, without any extra expense".

Dr. Gregory told of Minerals Separation's methods of getting evidence against Mr. Hyde and the Butte & Superior company. "They had got their door locked. They had it fortified in every way so as to make it impossible for us to get in. So we were compelled to trespass—absolute robbery. Our chief engineer went right into the place by force", "Mr. Nutter, and he took some of the stuff and put it into a bottle, and they nearly knocked his head off, and they followed him", "and in the meantime he had posted the bottle under registered cover, and so on, to our patent lawyers". "You have to set a thief to catch a thief, don't you know." "We may have occasion to employ men who will use their ingenuity and skill to get into places and find out what people are doing." "If I were to go and to ask them to let me in, they might ask me to walk out, or what not; so we have to use all the modern methods that everybody uses, as detectives." Referring to these methods, Mr. Ballot testified: "It was an awkward thing to do and an unpleasant thing to do, but it was a necessity. That necessity required a man to handle it carefully." Accordingly a mining engineer who had formerly acted as agent for Beer, Sondheimer & Co. was asked to "get the necessary information", and, according to Mr. Ballot, upon his recommendation a "man was engaged at a regular salary and proceeded to Butte and there entered the service of the Butte & Superior company, and got the information, reported the information, which was sent to the New York office—I think most of the correspondence was afterwards addressed to myself". "The men who got the information were never put on the stand." Numerous letters between these spies and this former agent of Beer, Sondheimer & Co., and Mr. Ballot and other officers of Minerals Separation North American Corporation referring to the employment of these spies and their compensation by Minerals Separation and their reports of their observations at the plants of the Butte & Superior company, the Miami Copper company, and elsewhere, including one letter, dated January 10, 1918, upon the letterhead of the Salt Lake City representative of Beer, Sondheimer & Co., Inc., addressed to Mr.

Ballot and informing him that the writer had "secured by devious and most unethical methods a sample of X Cake which I am sending by registered mail to Mr. Higgins today", were put into the record by the Federal Trade Commission's counsel.

Dr. Gregory stated that Minerals Separation did not guarantee the validity of its patents, and referred to its "dangerous patent position". Under clause No. 6 of its license agreement, Minerals Separation, according to Dr. Gregory, reserves the right to edit publications by its licensees on the subject of flotation. "As long as it does not in any way hurt us," "we are not concerned about it." "Your opponents never hesitate to attack you from any quarter that it is possible to attack from. I mean, if you take out a patent, they immediately bind us to anything that is in that patent, by saying, 'Why you yourselves called this a froth flotation. How can you say that that is not the same as the other'." "They have tried very hard to fix us to certain things in order to invalidate our patents by quotations from statements of our employees." "Therefore, we consider it wise, especially when our patent position is in such a dangerous position, not to allow half-cooked and half-baked statements to come out, the responsibility of which ultimately rests upon us. That was one of the reasons why we came to the conclusion that, while it may seem that the outer world does not get half-baked ideas, we did not think it right that they should get to know things under conditions which they would use against us. It is self-protection." "I would say that it was an absolute dereliction of duty on my part if I allowed an employee of ours to go and ruin the prospect of a company just because he wanted to air his views, which might be nothing or which might be something; and that is the reason that we introduced that in that contract." "We have had requests, which we have more often refused, when we have discovered that it is not right, or where we have been able to satisfy ourselves that it would be innocuous, we have allowed it; but it has done us harm, nevertheless, although we thought that it was innocuous." "We have to take our chances, to satisfy the vanity of our licensees. It does not mean money to them so much as it means the publication of their works, etc."

"This process," said Dr. Gregory, describing flotation, "is so jolly simple, you have only to take the stuff and put it in the box—I don't care what kind of a box you like to put it in, you know; you can put it into any sort of a box, and you can put a paddle into it, and shake it up, and it will come out; it is finished. It is so jolly simple, as I said before, that everybody thinks they can work this."

Neither Dr. Gregory nor Mr. Ballot would admit that there were any authoritative books on the subject of flotation. Dr. Gregory stated that he had not read Mr. Rickard's book, and Mr. Ballot testified: "Minerals Separation permitted T. J. Hoover to write a book, or compile a book. T. J. Hoover was general manager of Minerals Separation for a period of years. The manuscript of that book was submitted to Minerals Separation di-

rectors for approval. There were certain excisions made from it, because it was considered impolitic at that time, as against the company's commercial interest, to publish certain things, as the company was engaged in very active litigation. Some of these decisions he respected, and I think some of the matter was printed even without permission, without being finally passed." Mr. Ballot declared, however, that he had not read Mr. Hoover's book.

Mr. Frohnknecht testified that he came to the United States from Germany in 1906 with Mr. Elkan to take charge of the American branch of Beer, Sondheimer & Co., with which firm he had been connected in Frankfort for several years previous. Mr. Frohnknecht was a German subject, but took steps to become an American citizen in August 1914, immediately after the European war broke out. Speaking of the business transacted by Elkan and Frohnknecht as the New York branch of Beer, Sondheimer & Co., of Frankfort, ex-Secretary of War Lindley M. Garrison, counsel for Frohnknecht, stated that unquestionably it was entirely the business of the German firm.

Elkan and Frohnknecht handled the Minerals Separation agency for Beer, Sondheimer & Co. until October 5, 1914, when they took it over for themselves, receiving 17,500 shares of the (1913) American syndicate stock in lieu of commissions. Upon the organization of the North American corporation, each became entitled to 17,500 shares of stock, and the North American corporation took over the entire management of Minerals Separation affairs in the United States.

In 1915, Beer, Sondheimer & Company, Inc., was organized, taking over all Elkan and Frohnknecht's business except Minerals Separation matters, and Elkan became president and Frohnknecht vice-president of the new company. The offices of Beer, Sondheimer & Company, Inc., adjoined those of Minerals Separation North American Corporation at 61 Broadway, New York. Although Minerals Separation North American Corporation rent a part of their space from Beer, Sondheimer & Company, Inc., and the president and vice-president of Beer, Sondheimer & Company, Inc., were general agents of the latter and each owned a large block of Minerals Separation North American Corporation voting-trust certificates, until the Alien Property Custodian, in Washington, intervened and took over these certificates on the ground that they really belonged to Beer, Sondheimer & Co. of Frankfort, Germany, it was emphasized by the Minerals Separation representatives of Beer, Sondheimer & Company, Inc., and Minerals Separation North American Corporation have no real working arrangement or understanding at the present time.

The hearings have been adjourned for a few weeks to permit Federal Trade Commission's counsel to study the evidence introduced, and to examine further the books and records of respondents.

DURING 1918, 400 tons of strontium was produced in the United States, compared with 4035 in 1917.

Operation of the Case Oil-Fired Assay-Furnace

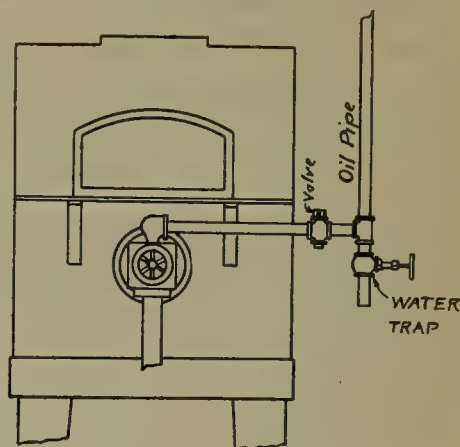
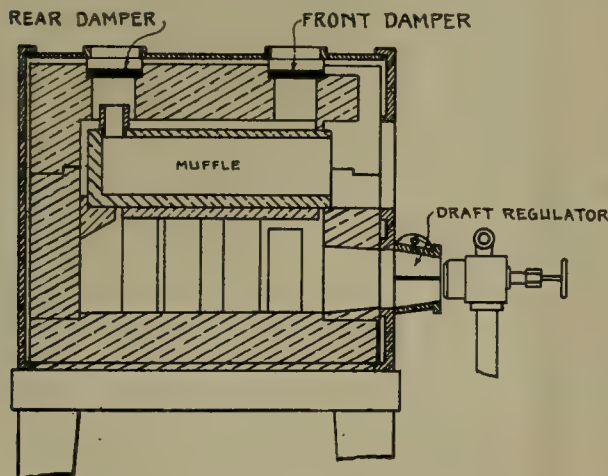
By F. BORZYNSKI

The introduction and extensive use of the Case oil-fired assay-furnace, brought forth a large number of complaints. Certain assaying establishments, schools, and individuals using the furnace, stated that it was unsatisfactory; the chief objections being the difficulty in cupeling and the great difference of temperature between the front and the rear parts of the furnace. Some users of the Case furnaces even went so far as to scrap them, one of these being a prominent Western mining-school.

Most of the complaining assayers stated that the only way they could cupel, was to open the door of the furnace. This is a serious objection, because on opening the door

nace is to be started. When the motor attains full speed, a small piece of waste previously soaked in gasoline is lighted and introduced into the furnace. The waste is held near one side of the front baffle with a pair of cupel-tongs and makes a satisfactory kindling. The oil and the air are then turned on gradually until about six inches of flame is visible above the front damper. The furnace smokes for a minute or two, but it soon stops, and the flame appears first above the front and then above the rear dampers.

In a single-muffle furnace, it is generally necessary to open the air-valve as wide as possible. When only a part



the front part of the muffle cools to such an extent that the buttons freeze. If an attempt is made to keep up the temperature of the furnace by increasing the flame, a reducing instead of oxidizing atmosphere is produced in the muffle and the cupellation stops entirely. This condition is intensified if there are any cracks in the muffle, for then the reducing fume enters the interior. The reducing gases not only stop the cupellation, but they are also absorbed by the cupels and the molten metal, and when the amount of fuel is reduced so as to re-start cupellation a violent spitting is caused by the released gas.

I have used several types of this furnace in actual assay-work and found them satisfactory in every way. It is hoped that the following description of the method of operation as practised by me will interest users of the Case furnace who have experienced difficulties in getting the best results.

Before starting the furnace, the draft-regulator and both dampers are opened wide. The air-valve is set at 'off' and the blower started. It is necessary to have the air-valve closed, otherwise the strong blast of air entering the furnace will extinguish the light with which the fur-

of the equipment of the multiple-type furnace is used, there is an abundance of air; only enough of it for perfect combustion is admitted into the furnace and the draft-regulator is kept closed at all times. In order to produce the necessary reducing-flame for making fusions and to heat the front end of the muffle, the rear damper is nearly or entirely closed. The front damper is kept open always. When the rear damper is closed, it is found that a considerable part of the flame from the furnace is entering the muffle through the vent at the rear. By admitting a sufficient amount of oil into the furnace, a flame is caused to play outside the muffle, making the temperature in the front part nearly if not quite the same as that in the rear.

The cupels are placed in the muffle immediately after the fusion charges are withdrawn. The condition of the furnace is not changed in any way until a minute or two before the lead buttons are placed in the cupels, when the rear damper is opened wide. As soon as the buttons are placed, the front door of the muffle is closed, keeping only the slot open. When all the buttons are melted and ready to cupel, the air and oil are cut down to half the amount

necessary during fusion and the front regulator closed if still open.

Starting with a cold furnace, the first fusion is obtained in about 45 minutes and each succeeding fusion in a little less than 30 minutes. A half-hour is more than sufficient to cupel a muffle of 20-gm. buttons. The door of the furnace is shut at all times except when placing or withdrawing the cupels or the charges from the muffle, and in this way the chilling of the front part of the muffle is avoided.

When setting up the furnace, it is well to place a water-trap somewhere in the oil-pipe, preferably a short distance in front of the stop-valve. The arrangement shown in the enclosed sketch gives satisfactory results. All oils contain water and if no provision is made to remove it, much annoyance will be experienced in starting the furnace. This water, if allowed to remain in the pipe, will extinguish the fire soon after the furnace is started and fill the assay-room with smoke and the furnace with a mixture of oil and water.

Lead Deposits in South Africa

Lead ores are found in South Africa, as in many other parts of the world, in the limestone and dolomite of the older geological formations. Small pockets of galena, in some cases argentiferous, are frequently found in the dolomite series of the Transvaal. In the Pretoria series true veins are found carrying galena either alone or associated with gold, silver, copper, and cobalt. In the Pretoria, Rustenburg, and Marico districts are many vein-deposits of lead ores associated with copper, the best known being the Transvaal Silver mine in the Pretoria district, where argentiferous galena is associated with iron pyrite, copper pyrite, copper carbonate, and tetrahedrite, in a gangue of siderite. The vein is associated with a diabase dike. At the Willows mine is a very similar deposit but without the lead ore. At Eden-dale, four miles north of Hatherley a vein has been worked in which galena occurs in conjunction with zinc-blende and the usual oxidized ores of lead and zinc. The gangue material is mainly quartz and calcite. At Leeuwkloof the galena is found in the form of a large shoot in the dolomite underlying the shales of the Pretoria series, and at the contact with the shales. The shoot strikes north-west and dips to the south-west. The galena is of good quality, the 700 tons so far extracted averaging 73 to 75% lead. The value in silver is constant, always being between 2 and 4 oz. per ton. Associated with this lode is a large body of iron pyrite about 100 ft. thick. At Rhenosterhoek the deposit is also in dolomite, almost at its junction with the Pretoria series. It is similar in character to all the other small galena deposits in this district, the ore usually being discovered through small outcrops of galena showing on the surface, and in almost all cases decreasing in value at depth, usually being exhausted at a depth of about 50 ft. The Rhenosterhoek deposit was discovered in this manner some 35 years ago, and a small amount of galena was at that time taken out by means of open-cut workings. The

mine is now being worked through an adit driven into the base of the hill on which the deposit occurs, at a level of 75 ft. below the original outcrop, at which depth solid dolomite is found, and the vertical extension of the galena deposit, in its original form, appears to be reached. The ore is now extracted principally by over-hand stoping, and the deposit increases in value as the work approaches the surface.

LODE-TIN MINING is not popular in Australia, although it has provided the most profitable tin mines. The Mt. Bischoff and the Vulcan properties with many smaller ones in the Irvinebank district in Queensland, may be cited in this regard. At the same time lode-tin mining shows as large a proportion of failures as gold or any other branch of mining—perhaps a larger proportion. There are several reasons for this. Sometimes it is due to the situation of the property, where it may be difficult to secure and retain suitable labor, or a permanent water supply. Frequently it is due to bad management, or an unsuitable treatment-plant. The complex nature of the ore carrying the tin, or the erratic nature of the deposit, may be contributing factors. Often a proposition that ought to pay handsomely, if worked on a fairly large scale, fails because only a small and unsuitable plant is provided; an attempt is made in that case to work only the richer portions. However, with the gradual elimination of the alluvial deposits as producers, the increasing demand for tin, and the consequent probable favorable price to producers, lode-tin mining is likely to receive greater attention in the future, especially as more economical methods become available and as many of the complex ores can now be satisfactorily treated. This is satisfactory as far as Australia is concerned, for there are a large number of deposits of lode tin in the States. In New South Wales alone, according to Carne's 'Tin Mining Industry', considerably over 200 are mentioned as having had more or less work done on them; in addition there are a large number of others, some of a promising character. Probably there are, at least, as many in Queensland, and there are a number in the Northern territory. In Western Australia there are a few that have had work done on them. Even in South Australia, which produces no tin at present, there are tin-bearing formations.

CADMIUM produced in the United States during 1919 amounted to 99,939 lb., compared with 127,164 lb. in 1918 and 207,408 lb. in 1917, the maximum output in the history of the industry. The production of cadmium sulphide was 31,197 lb., compared with 51,702 lb. in 1918. The combined value of metallic cadmium and cadmium sulphide in 1919 was about \$160,000, compared with \$258,518 in 1918 and \$376,036 in 1917. Though prices of cadmium were somewhat lower in 1919 than in the three years immediately preceding, the industry closed the year in better condition than in 1918, for the reason that the consumption practically reached the level established in 1916-17, and this with the decreased production operated to reduce stocks.

Mining in Narrow Stopes

By E. A. COLBURN, Jr.

The mining of narrow veins in hard or tough country-rock presents problems which differ materially from those faced in the extraction of ore from large deposits. Veins of this character must be composed of high-grade ore, and it must be saved in as clean a condition as possible in order to carry the extra cost per ton entailed by the mining of small ore-shoots. It is difficult to produce a high-grade ore on account of the relatively large amounts of waste that must be broken to provide space for working, and it is equally difficult to break the ground when it is mined in such narrow stopes as are necessary to recover the ore clean.

To mine such orebodies at a profit requires extra supervision of the ordinary miner, or else a class of miners more highly trained in this particular work than it is usually possible to obtain under company operation, and as a result the lessee has largely taken over the mining of narrow or pinched ore-shoots even in the larger mines. It may be proper to say here that this is especially true since the start of the world war and the era of high prices both for labor and supplies. The shortage of labor has been so great at times that in certain districts it has been impossible to secure men in any other manner, and even the larger stopes have been leased or the work done under contracts allowing the miner favorable terms.

The fact that the efficiency of men under company pay has dropped materially since the War has resulted in the abandonment of many stopes that were formerly on a paying basis under company operation. Many of these stopes are leased to miners who either do their own work, or who have the opportunity for closer supervision over the men that they employ than possible where operated on company account. The efficiency of the leasing system is due largely to the willingness of the miner to do more and better work for himself than for a company.

The advantages of the leasing system, where applied intelligently on small ore-shoots, are generally acknowledged, and are reflected not only in current production but in greater prospecting activity. Each lessee is continually looking and prospecting for further ore upon which he may work when his present lease expires, thus forming a crew of intelligent prospectors that the company could by no means afford to duplicate.

A few practical suggestions drawn from long experience with the leasing system when operated in connection with narrow veins should be of value to others operating under like conditions.

The old system of stripping the hard streaks and gouging the soft ones is in use to a limited extent where machine-drills are not available, and where it is imperative to secure a high-grade product on account of heavy freight and treatment charges; but this has long been

discarded in districts where the ore is milled locally and where tonnage is a decisive factor. Under this stripping system one or two rows of holes are drilled in one or the other wall, according to their relative hardness; after the holes are blasted the ore is removed from the wall by means of gads, or by 'pops' drilled at intervals back of the streak. When the veins are composed of soft ma-

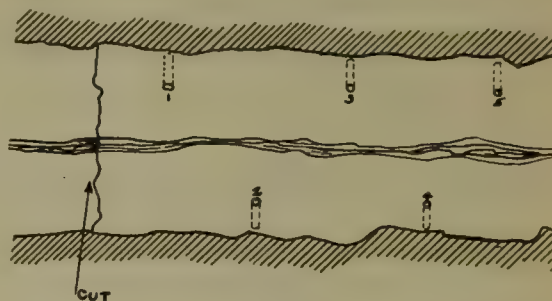


FIG. 1

terial, the ore is gouged ahead as far as possible; and later as much of the waste as is necessary to make room is drilled and blasted. This method is slow and wasteful, as a certain amount of ore is lost in the filling. The cost per ton is high and the tonnage low.

In case a vein is being mined under such conditions it

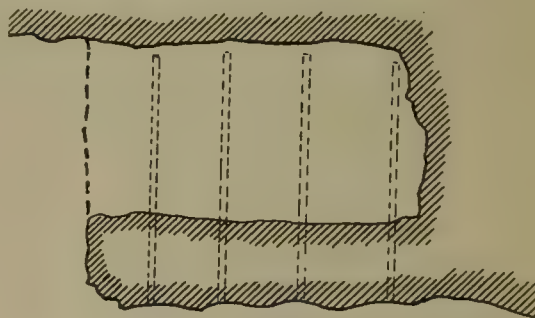


FIG. 2

is possible to drill directly in the ore; one row of holes is drilled in the vein and another row far enough away to produce a stope of convenient width. This arrangement allows a hole in the vein to be loaded heavily and blasted before its opposite wall-hole, thus pulverizing the ore and forming a cut to which the wall-hole can be slabbled. By this alternation much less fine waste is produced, as less powder is used in the wall-holes. Stope-rounds drilled in this way throw most of the ore into the fine or screening. The system is in general use at Cripple Creek and in other gold districts where the veins favor such procedure. The coarse waste is easily sorted out, either underground

or on surface, as conditions may demand, and any coarse ore that does not pulverize can also be saved in this way. This system has the advantage of leaving a good wall on one side of the stope; however, in a vein that is given to jumping about, this wall should be watched closely for stringers or feeders, which might carry off the ore.

Where veins that cannot be drilled are being mined, this system can be modified by straddling the streak with two rows of holes, drilling the ore-holes as near as possible to the ore and eventually bottoming or finishing them in the ore. This allows the drilling of all holes in the country-rock and the inspection of both walls of the vein. If a wall must be carried on one side of the stope, all the holes should be drilled on one side of the vein, with one row near and bottoming in the streak, to be blasted as described above.

In case it is not possible to drill directly in the vein, to bottom the holes in or near it, on account of its vuggy character or hardness, the two rows of holes are placed on opposite sides of the vein, as close together as possible so that they will still break to the required size. In soft ground the holes are often staggered as shown in Fig. 1, which represents the back of a stope as seen from below. When the rock is homogeneous and free from slips, each hole is loaded with the same amount of powder; as this is rarely the case, however, the holes are loaded according to the judgment of the miner, due advantage being taken of all slips, or joints. Holes are shot alternately; that is, the first hole in one row is spit, and the first in the other row, and so on till the round is completed. In hard rock the staggered round is not practicable, as it places too much burden on each hole and causes them to 'gum' or 'boot-leg'. Ordinarily in hard ground the number of holes would be doubled and placed opposite each other on each side of the streak, the round being shot in the manner just described.

When it is desired to carry the stope as narrow as 24 to 30 in., and an effort is made to break a 3 to 4-ft. cut, it often happens that the bottoms of the holes break out, leaving a bar of unbroken ground at the collar. In some districts this is called 'tunneling'; it is illustrated in Fig. 2, a section along the plane of a vein. 'Tunneling' often occurs in stopes passing through alternate layers of hard and soft ground whenever the holes collar on the hard rock and bottom in the soft. As the ribs must be removed to allow work to proceed, the labor and materials used are virtually wasted. Breaks of this kind must be avoided. The best remedy is the drilling of more and shorter holes, and the next best is the putting of more ground on the bottoms of the holes. The former is open to the objection that a machine-man can accomplish more drilling in a given length of time when drilling long holes than when drilling short ones. This loss, however, is inevitable and will amount to much less than that caused by 'tunneling'. Putting more burden on the bottoms of the holes is satisfactory in soft ground but is poor practice in hard stopes, as the extra powder necessary to cause a clean break will often shake up the wall-rock and cause danger; it will also produce a greater pro-

portion of fine waste, and thus lower the grade of the ore.

Whenever a narrow vein is being mined for mill-ore, and no attempt is made to sort out a high-grade product for shipment, the system of drilling one row of holes in or near the vein is best, because the ore is almost entirely segregated in the fine and can be separated from the waste by means of grizzlies or screens. A grizzly with 3-in. openings will usually produce a sufficiently high-grade product, and the oversize or waste can be sorted, if it contains enough ore to pay the expense of the extra labor. It is apparent, however, that the best method of mining any particular sort of narrow orebody is dependent upon the conditions surrounding the vein and upon the grade of the product most desired.

Where air-feed hammer-drills are used it is common practice to drill all holes in a narrow stope from one plank set in a convenient position, usually near the foot-wall. When holes are drilled in this manner it is difficult to estimate where they will 'finish', as the holes in the different rows are farther apart at the bottoms than at the collars, like a hand with the fingers stretched apart. All holes should be drilled as nearly parallel as possible to the vein and the other holes in the round, thus avoiding wedge-shaped blocks between holes and producing a more even excavation after blasting.

A NEW TYPE of asbestos was discovered in central Transvaal, South Africa, about the year 1907, according to Oliver Bowles in a recent bulletin of the U. S. Bureau of Mines. The name 'amosite' was given to the fibre in 1918, from the initial letters of the Asbestos Mines of South Africa, the company chiefly interested in its production. Amosite is a monoclinic ferrous amphibole, with or without soda, and containing variable amounts of aluminum, magnesium, and calcium. It thus most nearly resembles crocidolite or blue asbestos. The deposit occurs along the Elifants river in the Lydenburg district, the fibre-bearing rocks occurring in an area 60 miles long and with a maximum width of 6 miles. Commercial production began about 1916, and while no figures are available for the production of this particular variety, the increase in production for the Transvaal of 55 tons in 1915 to 3192 tons in 1917 is to be attributed chiefly to the recent active development of the amosite deposits. The material occurs as interbedded cross-fibre veins in banded siliceous ferruginous slates. The productive veins vary from 2 to 7 inches in thickness. The most remarkable feature of the fibre is its great length. A maximum fibre length of 11 inches has been noted, while the bulk of the supply from the most important mine averages about 6 inches in length. The fibre is said to be strong, flexible, and therefore of spinning quality, though, on account of the unusual fibre length, certain modifications are necessary in spinning machinery. The chief production is from two mines, the Egnep, producing about four-fifths, and the Amosa, one-fifth of the total. As a source of supply for America the deposits are handicapped by excessive transportation costs.

Engineering Activities of Universities and Government Bureaus

*A sub-committee of the Commonwealth Club of California was organized at the suggestion of S. H. Dolbear, chairman of the Mineral Resources section of the club, to investigate the scope and character of the activities of various State and Federal institutions, universities, and members of university faculties in the field of engineering, with particular reference to the mineral industry. The rather imposing list of Federal and State institutions engaged in scientific and engineering activities of one sort or another in California and various specific instances of efforts to extend the field of activity of certain of these organizations furnishes ground for the belief that there is a definite trend toward socialization in the field of applied science. The purpose of the Committee was to ascertain the facts and if possible formulate some judgment as to whether existing conditions and tendencies are desirable or otherwise. The Committee has endeavored to approach the subject from a broad standpoint and consider matters in relation to the public good rather than from the standpoint of possible injury to the individual.

The following objectives may be set down as the criteria by which existing policies and practices may be judged:

1. The advancement of fundamental knowledge in science and technology.
2. Suitable provision for the application of scientific and technologic knowledge in the service of mankind.
3. The training of men for work in the above field.

The Committee through its members has received statements in regard to the policy and practice of the University of California, the California State Mining Bureau, and the U. S. Bureau of Mines. At the general meeting of the Mineral Resources section, on December 2, 1919, Dr. R. L. Wilbur outlined the general policy of Stanford University in regard to professional activities of members of the university staff. Fragmentary information in regard to the activities of other universities and Government institutions has also been received. In connection with university activities it is to be noted that two fairly distinct matters come up for consideration, namely, what may be termed the official activities of branches of the university, as for example, the farming advisory system of the College of Agriculture of the University of California, and the so-called private professional activities of members of the university staff. In the case of Federal bureaus, such as the U. S. Geological Survey and the Bureau of Mines, regular employees are not permitted to engage in private work, consequently the Committee is concerned only with the work of these institutions as such. Members of these bureaus have at times engaged in private practice when on leave of absence.

*This report is published by the permission, but not, as yet, with the endorsement, of the governors of the Club.

UNIVERSITY ACTIVITIES. Considering first the private professional activities of members of the university staff, work of this sort is ordinarily done during vacation periods or odd hours and consequently the control exercised over it by the institution is likely to be indefinite if indeed it exists at all. That men should feel compelled to undertake such work in order to augment insufficient compensation from the institution to which they belong is, we believe, a condition not consistent with the public good. Outside work when undertaken should be entered into from higher motives than mere monetary reward.

In the field of applied science professional experience undoubtedly enhances a man's effectiveness as a teacher both through the actual knowledge and insight gained and also by the added authority with which he can speak. First-hand knowledge of those qualities which are needed to make a successful engineer is essential. We are disposed to doubt whether the mere visiting of engineering operations can replace actual professional activity from the standpoint just considered.

It is essential also that technical knowledge should be continually advanced through research. Such research to be effective must be based upon an intimate acquaintance with the problems arising in industry. For this reason also something more than superficial contact with industrial activities seems desirable on the part of the university man. This discussion obviously does not apply to research in so-called pure science. The danger that excessive demands will be made for the professional service of university men is to a considerable extent offset by the fact that employers of engineering service prefer in general to command the entire time of their engineers. The Committee finds itself in agreement with the view expressed by Dr. Wilbur that a certain amount of outside professional experience on the part of university men is desirable, but that such work should be taken in harmony with the primary functions of the university, namely, advancement of knowledge and training of students. Moreover the results of such professional work should always be available to the public and professional service should preferably be rendered in connection with public projects.

From the standpoint of both the employers of engineers and of the practising engineers themselves, with whom the university man would appear to compete in his professional activities, the Committee has not learned of anything in existing practice which calls for unfavorable criticism. It is for the employer to determine how he can best secure the assistance needed and the right sort of an engineer need not and will not fear competition from individuals. In substance the primary consideration as regards the professional activity of university men is whether or not such activity increase a man's usefulness

in connection with the work of his institution. Of this the university must be the judge.

Turning now to the professional activities carried on as a regular part of the work of educational institutions, we find an excellent example of this in the comprehensive service rendered by the College of Agriculture, University of California. The Committee is not prepared to express criticism as to the merits of this plan in the field of agriculture. It may be pointed out that the policy which is followed places the institution in direct competition with its own graduates—a condition which would seem likely in time to divert students from the agricultural courses. Moreover, we believe that in general free advice and service are neither of as good quality nor as effective as that for which payment is made.

The Committee's attention has recently been directed to the comprehensive plan announced by the Massachusetts Institute of Technology for technical service along chemical lines. While the final decision as to the merits of this plan will be made on the basis of the results achieved, we are inclined to feel that on the one hand, industrial concerns are not likely to find the service rendered as satisfactory as that obtained from private industrial laboratories and consulting engineers, and that on the other hand, the rendering of professional service on the scale proposed is not likely to prove compatible with the primary educational function of the institution.

GOVERNMENTAL ACTIVITIES. Since State and Federal bureaus are supported by public funds, it is obvious that their proper activities are limited to those which promote the public welfare. As a guiding principle then it may be stated that the public interest should be at least as great as the private interest in any project undertaken by such institutions. In general terms, suitable projects will include work of a fundamental scientific character and technical work, particularly of a pioneer nature, on subjects where the existence of a community or group interest makes it impractical for private individuals or institutions to take up the matter. On the other hand, in view of the great need for constructive work along scientific and technical lines, it seems undesirable in general that the Government institutions should duplicate work which is being competently handled by private enterprise. In reviewing the activities of the Government institutions most intimately related to the mineral industry of this State, namely, the California State Mining Bureau, the U. S. Geological Survey, and the U. S. Bureau of Mines, we find that there is a general conformation to the principles just stated.

It is to be noted, however, that there is within nearly all Government bureaus a pressure for expansion, which at times threatens encroachment on what is now generally accepted as the proper field for private activities. As an example of this mention may be made of the recent suggestion of the director of the Bureau of Standards, before a committee of Congress, that this Bureau undertake the testing of cement for general industrial use.

While expressly withholding comment on the gradual trend toward socialization of industry and speaking par-

ticularly for the mineral industry the Committee believes that the rapid and extensive institutionalizing of engineering service is highly impractical and undesirable. If such a development is to be effective it must come through a slow process of evolution.

Chromite Production in 1919

The maximum domestic production of chromite was reached in 1918, when 82,430 long tons of crude ore was shipped and when 42,687 tons was left in the hands of the miners at the end of the year. In 1919, according to J. S. Diller, of the U. S. Geological Survey, the shipments reached only about 3900 tons, of which about 1000 tons was mined in 1918. The shipments from California alone, chiefly from five producers, amounted to nearly 2000 tons; the remainder was shipped from Oregon, Wyoming, and Maryland.

In Oregon more than 600 tons of chromite, carrying 45% of chromic oxide, was mined in the last half of 1919 and nearly all of it was sold, some of it to consumers as far east as the Great Plains. In California the Placer Chrome Co. moved its mill to the mine and continued concentration in 1919 in the hope of maintaining the industry.

A few tons of chrome sand was washed out in 1919 in Maryland, and prospectors still continue work near the Pennsylvania State line in the hope of finding large bodies of chromite near those that were mined out 40 years ago. Wyoming was the second largest producer in 1919. Although production there has now stopped, a small force of men continues development in anticipation of better conditions.

Prices have been falling ever since the Armistice was signed and apparently have not yet reached the bottom. Lump ore containing 45 to 48% of chromic oxide is selling at 20c. per unit f.o.b. at points in California, and concentrates containing 48 to 50% of chromic oxide are selling in that State for 40 to 50c. per unit. In New York, however, ores containing 35 to 40% of chromic oxide are quoted at 60 to 85c., and ores containing 48% or more are quoted at 70c. to \$1.25 per unit.

The War Minerals Relief Commission is still busy adjusting the claims of those who began the mining of chromite during the War but were obliged to cease operations after the Armistice was signed when further production could not be made at a profit.

The total imports of chromite in 1919, according to the Bureau of Foreign and Domestic Commerce, amounted to 61,404 long tons, which was only 61% of the quantity imported in 1918 and a smaller quantity than has been imported during any year since 1912. Cuba, Australia, Canada, and French Oceania, supplying quantities of ore in the order mentioned, furnished 71% of the total imports. The average price was \$22.49 per ton. The importation of high-grade ore from Guatemala is increasing. Prices may be regulated by the competition of chromite from India with that of Rhodesia, New Caledonia, and Brazil.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

COPPER QUEEN COMPANY EDUCATES MINERS.

DOS CABEZAS.—Several milling plants are either being operated or are in course of construction. The Central Copper Co., which was organized last year, has taken over the Mascot mine and recent development work has opened sufficient ore to warrant the erection of a mill. At the Gold Prince mine a 300-ton mill is rapidly nearing completion. During the past three years a large tonnage of ore has been developed. Ore produced during development has been treated in a small mill which has been leased. The Davies property is also operating a small mill.

KINGMAN.—The Emerald Isle Copper Co. has increased its capitalization from 500,000 to 1,500,000 one-dollar shares to provide funds for further development and construction. It is said that the present 50-ft. shaft and several shallower shafts have developed 200,000 tons of oxidized ore running 2 to 3% copper. About 1000 tons of the ore has been leached and the copper recovered electrolytically. The mine and mill are one-half mile from the Kingman-Chloride branch of the Santa Fe railroad.

TUCSON.—It is announced that the Cerro Colorado silver mine in the Arivaca district is to be re-opened. This mine is one of the oldest in Arizona and up to 1880 had produced over \$2,000,000 in silver. The ore was very rich, containing chloride and native silver. It is in the neighborhood of the Cerro Colorado that the famous Planchas de Platas, the largest lumps of native silver that have been found in Arizona, originated. The Arizona-Tucson Copper Co., nine miles south of Tucson, reports the cutting of ore in the new vertical shaft. For several months the company has been shipping ore running high in gold from the glory-hole at the surface, at the rate of one carload per month. Several weeks ago sinking was continued with a view to getting under the orebody, which was being mined through the glory-hole. A crude-oil engine hoist, head-frame, shops, and bunk-houses have been built and preparations are now being made to place the compressor and increase the working force.

A. J. Harshberger, manager for the Arizona Tonopah Mining & Milling Co., situated north of the Arizona Tucson, reports that the main shaft has reached a depth of 145 ft. and has cut ore running high in gold, silver, and copper. In a prospect shaft to the north of the main shaft, high-grade silver-lead ore was struck at the 100-ft.

level. Thirty feet of drifting has been done with encouraging results. It is reported that C. G. Bent and associates of Bisbee have taken over the Papago Chief mine in the southern Baboquivari mountains. There is said to be a large amount of copper-silver ore on the dumps, the mine having yielded high-grade shipping copper ore in the past. A small mill is to be erected on the property immediately.

GLOBE.—During the recent railroad strike the Iron Cap Copper Co. was forced to close down for three days as it is dependent on a branch of the Arizona Eastern railroad to deliver its ore from the mine to the Inspiration mill and the International smelter. The Miami Copper Co. was in a like position, but having ample storage room at the mine for its concentrate, continued to produce and store the output. The Inspiration Con. Copper Co., Old Dominion company, and Arizona Commercial continued operating without interruption. The Van Dyke Copper Co. has passed the 1300-ft. mark in its shaft and is progressing at the rate of six feet per day. It may be recalled that the world's record for shaft-sinking was made in this shaft two months ago. The Old Dominion company is doing extensive development work on the 1800-ft. level on the east side, and on the 1900 and 2000-ft. levels on the west. Some very good new orebodies have been opened in other sections of the mine. The Old Dominion sank from the 1800 to the 2000-ft. level in two shafts. About 7,000,000 gallons per day are now being pumped from the mine. Production averages about 850 tons per day.

JEROME.—A. E. Eldridge, formerly naturalization examiner for the southern district of California, Arizona, and Nevada, under Fred Jones, examiner in charge, has resigned from the Government service to become assistant industrial superintendent of the United Verde Copper Co. at Jerome. His work will be confined strictly to the miners, the principal idea being to get in close touch with the men and endeavor to win their confidence and impress on them the value of co-operation. The William Simpson Construction Co. of Los Angeles has been awarded the contract for the construction of the new hospital for the United Verde Extension Mining Co., on the Hogback in Jerome. The building will be reinforced concrete, class 'A' construction, capable of accommodating 35 patients and built in such a manner that additional wings can be added at any time without disturbing the symmetry of the design. The plans will embody many modern ideas.

BISBEE.—During the month of April, examinations

were held by the Copper Queen for the issuance of certificates to skilled miners who had completed the Copper Queen course in practical mining. Thirty-three men took the examinations and of this number 28 received certificates. The examinations were both written and oral and the student was required to pass with a grade of at least 65% in all tests. It is understood that from now on the men will be required to attend the full course of 35 lectures before they are allowed to take the examination. The certificate states that the possessor "having completed the practical mining course as prescribed by the educational department and passed a satisfactory examination is entitled to this certificate as a testimonial of such attainment and evidence of competency as a skilled miner". It is estimated that approximately 161 men are taking the lectures this year. What may be considered as Arizona's greatest 'legal battle' was concluded on April 30, when the jury brought in a verdict of 'not guilty' in the case of H. E. Wooton, charged with kidnapping in connection with the Bisbee deportations of July 1917. The trial of the 149 defendants in the 'blanket case', likewise accused of kidnapping in connection with the deportations, will commence on June 7.

COLORADO

OUTPUT FROM CRIPPLE CREEK DISTRICT.

CRIPPLE CREEK.—The Empire State shaft of the Isabella Mines Co., in the centre of the Bull Hill area, has been unwatered to the 1000-ft. level and sinking to the 1500-ft. point will start as soon as the contract is let. The Empire will become the main working shaft. The shaft-house, ore-house, and machinery at the Lee shaft were destroyed by fire early in the year.

Cable to permit sinking to the 2000-ft. level, a skip, and other mine equipment for the Blue Flag Gold Mining Co.'s main shaft on Raven hill has been delivered. A station has been cut at 1400 ft. and cross-cutting is now under way. Drifting both east and west is in progress at the 1200-ft. level.

The gross production from mines of the district for April, as reported by the Golden Cycle and Portland mills, and by the district representative of the American Smelting & Refining Co., was 35,295 tons with an average value of \$13.50 per ton, and gross bullion valued at \$473,590. The treatment at the mills was as follows: Golden Cycle, 19,000 tons, average value \$19 per ton, gross value \$361,000; Independence mill at Victor, 15,000 tons, \$3.86 per ton, \$60,000; A. S. & R. smelter at Pueblo, 700 tons, \$75 per ton, \$52,500; total \$473,590. April dividends totaled \$90,000 and were paid as follows: Portland company, \$45,000, Golden Cycle company, \$45,000.

IDAHO SPRINGS.—The milling plant of the Mountain States Silver Mining Co. is to be increased to 300 tons capacity. A California redwood-flume is under construction to conduct water from the company's reservoir on Chicago creek, and when completed water-power will generate 900 hp., sufficient to operate a plant of larger capacity and furnish power for compressors and electric generators. The mines of the company, the Little Mattie-

Newton group, are situated $2\frac{1}{2}$ miles west of Idaho Springs. Ore-reserves, estimated at 200,000 tons, are reported by D. A. Knight, the company's engineer, with a recoverable content worth approximately \$10 per ton. The company also owns the Silver King group at Georgetown. Plans to extend the line of the Colorado Power company to operate the plant at the portal of the Aurora tunnel are being made. The tunnel will then be extended to cut, at depth, veins exposed in former shaft-workings. The property when operated 17 years ago produced a good grade of gold-silver-copper ore.

BRECKENRIDGE.—Deep snows have curtailed ore-shipments, but with road conditions improved, a good tonnage of ore mined during the winter will be moved. Four of the dredges have resumed work. Lessees on the Germania mine are reported breaking rich silver ore in a vein four feet wide and will soon start shipments from a streak of high-grade silver-lead ore that assays 150 oz. silver. The mill at the Gold Run mine is being put in shape to treat zinc-iron sulphide from the Jessie mine, owned and operated by Geo. F. Roth and associates of Rochester, New York. The Blue Flag Gold Mining Co. has made connection between the Laurium Transportation tunnel and the east workings of No. 1 tunnel. Production will continue and the ore will be brought out through the Laurium tunnel. A vein four feet wide, assaying \$30 per ton in gold and silver, is being developed.

MICHIGAN

COPPER PRODUCTION DURING APRIL.

HOUGHTON.—Production from Michigan copper mines during April declined again. The Osceola Consolidated is an example. The total output for April was only 44,235 tons of which amount 10,500 came from the old mine and the remainder from the Kearsarge. This compares with 50,000 in March and 49,000 in February. Ahmeek produced 64,500 tons in April compared with 68,000 tons in March, and the same tonnage in February. Centennial produced 6750 tons in April compared with 7000 in March, while Allouez did somewhat better than in the previous month. The figures were 20,800 tons as compared with 20,500 in March and 14,321 in February. Isle Royale kept its own mill going at full capacity in April and in addition sent 37,500 cars to the customs plant. Superior did well in April, the best for many months, turning out a tonnage of 1500. There was no shipment from the La Salle during the month.

Although the recently issued annual report of the Calumet & Hecla company does not make an elaborate report regarding the flotation-plant and its operation in the treatment of the product, there is significant assurance of the success of the slime department in the statement that an addition will be built to the present building to provide room for additional settling-tanks. The application of re-grinding, leaching, and flotation principles to the Calumet & Hecla output is confined to the conglomerate-lode ore, and on that product alone has it been found successful. The flotation-plant takes 3000 tons per day. The ore reaches the plant following treatment in

the re-grinding mills and in the leaching process, and more than two pounds of copper per ton is being saved. This is the last word in the recovery from the conglomerate, and when the tailing goes out into the lake at the conclusion of the flotation treatment there is little copper left. The financial profit that the introduction of flotation makes for the Calumet & Hecla may be judged from the fact that conservative figures put the profit from the present limited operation at \$1.50 per share per year in normal times. The copper secured regularly, from the 3000 tons per day that are now handled, is approximately 1,600,000 lb. per year. The use of flotation at the White Pine and at the Winona properties was not war-

foot-wall to hanging. The vein in the south cross-cut was 15 ft. wide.

Mohawk's 'rich streak' on the 25th level continues to produce the best ore that is coming from any part of the mine. This is the richest portion of the Kearsarge lode yet opened on the Mohawk property and the shoot is of far greater length on the 25th than on any other level. This streak was opened first three years ago on the 22nd. It was found of greater extent on the 23rd, and on the 24th it was about on a par with the showing on the 22nd. Now at the 25th it is best of all and from the present indications it will take at least four months of steady mining to get out all of the rich ore in sight. No. 4 shaft is



TWIN SHAFTS AND CRUSHER-PLANT AT THE INSPIRATION MINE AT MIAMI, ARIZONA

ranted by the extensive experiments which are conducted a few years ago.

Arcadian Consolidated resumed operations on May 10. This company is not confronted with the difficulty of securing labor. For the present all the men needed are on the property; they are farmers who are working land under lease from the Acadian company. These men have applied for positions and most of them have previously worked underground and are experienced men. The first work will be undertaken at the New Baltic shaft. Operations in this shaft were suspended in September 1918 owing to lack of capital and shortage of labor. The Baltic shaft is down 500 ft. and the station was cut here. Further openings from this point will be made in the hope that the ore will be on a par with that found in the levels above. The New Baltic shaft made its best showing on the 400-ft. level, which was opened by means of cross-cuts both north and south of the shaft. The north cross-cut showed a 34-ft. vein with heavy mineralization from

being sunk at the present time to the 26th. No. 6 shaft is advancing below the 17th, and at No. 5 drifts are going both north and south. The Mohawk is running 65 drill-machines and is not suffering seriously from the chronic labor-shortage which is bothering some of the mines.

MONTANA

ORE-TRANSPORTATION BY AEROPLANE.

HELENA.—The Liverpool mine, in the Lump Gulch district, will reach a production of 30 cars this month. The new orebodies are holding out well and drifting to the east is following a vein of rich silver ore.

The Amalgamated Silver Mines Co. of Helena has decided to sink the shaft of the Free Coinage mine from 250 to 500 ft. Drifting will progress simultaneously with the shaft-sinking. Ore-shipments are being maintained from the third and fourth levels east of the shaft, and some ground to the west is being mined. Pumping in the

100-ft. shaft of the Stenwinder mine has been discontinued until the arrival of new machinery and in the meantime work is progressing on the extension of the tunnel. The ore mined assays as much as 70 oz. per ton. Sixty feet from the tunnel mouth the vein material pinched down to eight inches but showed a corresponding increase in silver assay. This ore assaying 200 oz. per ton is being sacked and shipped to the East Helena smelter.

BOULDER.—P. A. Danaher and M. Leyding of Helena have taken an option on the Shields-Ironside property situated 12 miles from Boulder. The property is well equipped with a 50-ton concentrator, machinery, buildings, and offices. The mine has been unwatered and shipping will commence soon. The ore contains copper, lead, gold, and silver.

NEIHART.—Small forces are at work on the Commonwealth, Hidden Treasure, and several other properties both in the Snow Creek and Carpenter districts. Many lessees are operating in the Broken Hill, Gault, Tom Hendricks, and other mines, and an active spring is anticipated.

COOKE CITY.—The operators of this district have been approached by the Alaska Airplane Corporation with a view to contracting for carrying out ore and bringing in supplies while awaiting the completion of a road to Gardiner. Each plane would be capable of carrying six tons of ore. The present cost of freighting by wagon would be cut in half and the acceptance of the proposal is very likely.

J. R. Jackson, judge of the district court, confirmed the sale of the Buffalo-Montana group of mines at Cooke City by R. J. McKay, receiver, to W. D. Marlow. Payments are to be made from operating profits. December 1925 is the date set for completion of payments.

BUTTE.—The Silver Butte Mines Corporation, operating the Corbin Copper Co. properties in Jefferson county, is taking over the property of the Butte-Ballaklava Co. The latter's bonded indebtedness and other obligations will be provided for with cash and stock. Each share of Butte-Ballaklava stock with an additional 50c. can be exchanged for a share of Silver Butte.

NEVADA

LEADVILLE MINES CO. SHIPS CONCENTRATE.

TOBAR.—Seven auto-trucks are hauling a half carload of silver-lead ore daily from the Spruce Monarch, 22 miles south of Tobar, on the Western Pacific in Elko county, and there is 1500 to 2000 tons broken and stored at the mine. The Spruce Monarch was first worked in 1870 and operations continued until 1902, most of the ore being treated in smelters built by different managements. When the price of silver increased the mine was owned by M. Badt & Co., bankers at Wells, and they financed on a small scale the Spruce Monarch Consolidated Mining Co. The old workings could not be entered economically and a tunnel was driven that entered ore 800 ft. from the entrance and at a depth of 400 ft. A raise was driven to the old 300-ft. level, where there was found a 45-ft.

width of ore from which carload shipments give a net smelter return of \$50 to \$70 per ton. Several hundred feet from this orebody another, 35 ft. wide, has been stoped to the 200-ft. level. The tunnel has entered the extension of these ore-shoots and at this depth a drift has been driven over 100 ft. in ore 8 ft. wide and assaying 20 to 40 oz. silver and 25% lead. Further development will be done and if the results are satisfactory it is planned to drive a 7500-ft. tunnel at a depth of 1500 ft. on the dip. Reports indicate that the Spruce Monarch is fast being developed into a mine. The vein extends into the adjoining claims of the Ada H. company, which are credited with an early-day production of \$70,000 in high-grade ore, and this company has started prospecting on a good scale. The Bullshead Mining & Smelting Co. owns the Bullshead mine and a 30-ton smelter, which was operated successfully early in the winter. There is estimated to be \$650,000 worth of ore in the mine and dumps. The company recently considered the sale of the mine and smelter for \$265,000. The management plans to drive a tunnel to cut the veins under the present levels.

LEADVILLE.—The first carload of concentrate from the re-built 50-ton plant of the Leadville Mines Co. was made a few days ago to the smelter at Murray, Utah. The plant was started on March 15 and since then it has been treating 20 tons of \$40 lead-silver ore daily, producing from this tonnage 5500 lb. of concentrate assaying \$200 to \$250 per ton. The Leadville, formerly the Tohoqua, is an old mine credited with a net production of \$156,000 under former management, the ore coming from above 350 ft. The ore now being mined is taken from tunnel and shaft-workings which are connected. The concentrator is at the entrance to the tunnel. A winze has been sunk 300 ft. from the tunnel and lateral work from the bottom has been started. The winze reaches 160 ft. below the bottom, or 500-ft. level, of the shaft and the finding of the extension of the ore-shoot now being mined would indicate a big reserve. The main vein of three cut by the tunnel has an average width of more than three feet and it extends through three claims for 3000 ft. The vein is principally quartz, the ore containing lead and silver sulphide, with small quantities of gold, zinc, and iron.

DIVIDE.—An orebody 100 ft. long that has been cross-cut for 12 ft. has been found 500 ft. south-east of the shaft on the 585-ft. level of the Tonopah Divide. The ore contains silver glance and it is the first important shoot of sulphide ore found in the mine. A winze has been sunk 40 ft. in high-grade ore. The 585-ft. level is at least 400 ft. above the water-level, according to the latest estimates. This is the first important shoot found on the 585-ft. level, which is the deepest on which lateral work has been done. The position of the ore is said by engineers to indicate that it has a more decided rake into the Gold Zone than was at first indicated. Failure to find ore on this level had been the subject of much discussion. A number of prospects closed during the recent labor trouble have not re-opened and the consulting engineer for several of the active companies states that he does not think there are more than a dozen mines being worked in the district. The

affairs of the Tonopah Divide for the last year continue to be discussed widely, particularly the opportunity afforded those on the 'inside' to speculate in the stock. Mining men describe as a 'fiasco' the rise and decline of the stock when taken in connection with the two mine reports and they feel that a sentiment has been created which will do injury to the mining industry in the State. The silence of the management over many months during which there existed a condition almost without parallel in the history of mining, coupled with the decline in the price of the stock and the alleged 'leak' in the last report, is eliciting some criticism.

GOLDFIELD.—Cross-cuts have been driven north and south for a total of 220 ft. from the west cross-cut on the 358-ft. level of the Florence. The west cross-cut has been stopped at a point 1061 ft. from the shaft. The drifts are being driven on a vein 21 ft. wide, from which good

Western Ore Purchasing Co. at Hazen. Excavations are under way at the property for six new buildings to house men with families. Cross-cutting from the 530-ft. point in the shaft of the Simon Contact property which adjoins the Simon Silver-Lead on the north is under way to explore for the downward extension of the ore opened on the 250-ft. level. Two shifts with machine-drills are employed.

OREGON

DEVELOPMENT OF THE CALIFORNIA MINE.

JOSEPHINE COUNTY.—A. Walker and H. P. Campbell are associated in developing the California mine 18 miles from Glendale. The property is situated near the Gold Bug and Copper Stain properties, and is equipped with a two-stamp sampling-mill. The vein averages four feet in width and runs \$23 in free gold. They have spent



50-TON CONCENTRATOR OF THE LEADVILLE MINES CO.

assays are secured, but ore has not been found. In working toward the Aurelia-lease shaft from the south-east cross-cut on the same level to secure air, a 17-ft. vein of quartz has been found. The south-east drift is 925 ft. long and little work will be done in it until the shaft has been reached.

MINA.—The main working shaft on the Simon Silver-Lead property has reached the 600-ft. point. A skip-pocket and a station are to be cut and laterals driven to prospect for the downward extension of the orebodies opened on the 400-ft., or sixth level. High-grade silver-lead ore, low in zinc, is being broken in a winze on the fifth level. The winze is being driven to determine the rake and dip of the ore-shoot in order that it may be cut on the sixth level. A carload shipment, purely as an experiment, was sent out recently from which the following smelter returns were received: 31.8 oz. silver, 31.9% lead, and 9.3% zinc. The dry weight was 73,483 lb.; net weight, 74,300 lb.; gross settlement, \$76.55 per ton; net returns, \$68.12 per ton. The shipment was sent to the

\$50,000 in development work and have run a cross-cut 651 ft. long at a depth of 300 ft. There are also drifts totaling 230 ft. on each side of the cross-cut. Work on the property was discontinued during the War, but was resumed last winter. The elevation of the mine is about 2500 ft. Aside from small deposits of stream gravel the rocks of the area are either Jurassic sediments or igneous intrusives. The general strike of the sediments and also of the contact between the sediments and igneous rocks is about N. 20° E.; the sediments dip steeply to the east. The ore is white quartz containing some pyrite.

GOLD HILL.—It is reported that William Piggott, of Seattle, who several years ago acquired control of the Oregon Iron & Steel Co.'s Oswego plant near Portland, has recently purchased the iron mine owned by the Garfield Iron & Lime Co., situated two miles north of Gold Hill, and that he will re-open the old workings and ship the ore to the Oswego plant. This iron deposit is within a mile of the main line of the Southern Pacific railway at an elevation of from 1850 to 2250 ft. The deposit con-

sists of limonite, hematite, and magnetite, occurring in lenses in Paleozoic sediments, which include some limestone and abundant argillite. The sediments are cut by a dike of granite. The history of the deposits dates back to the year 1870, when the locators, practical iron-ore experts, hauled several tons to Sacramento, the nearest rail point, and shipped it to Wales. The report on this test-shipment demonstrated that the ore was a high-grade hematite. During the early '80s two iron-experts, Burgess and Pomeroy, acquired the property, did some development, and made shipments, but on account of the low price of ore and the high transportation charges they abandoned the project. Later the property fell into the hands of the Garfield Iron & Lime Co., a Portland concern, that has let it lay idle since.

JACKSONVILLE.—The Blue Ledge copper mines in the Upper Applegate district, 40 miles out from Jacksonville, have resumed the shipment of three cars per week to the Tacoma smelters. The mine employed about 30 miners during the winter, while shipments were suspended, developing new ore. The scarcity of auto-trucks and teams this season will cause an increase in the cost of the haul to Jacksonville over last season's price of \$10 per ton. The shipments consist of ore running better than 12% copper and \$7.50 in gold and silver, while the lower grade ore is dumped at the mine for future reduction.

UTAH

PROGRESS AT THE TINTIC STANDARD MINE.

SALT LAKE CITY.—The threatened I. W. W. strike in the metal-mining camps of the State, set for May 1, failed to materialize. Floyd T. Jackson, special agent of the Department of Justice in this city, said the strike threatened to involve every mine at Bingham, Park City, and Eureka, as well as some other parts of the State. Walking-delegates, it is stated, were dispatched from Butte to Bingham to promote the cause of the striking miners in Montana. On the afternoon of April 30 a raid was conducted under the direction of Mr. Jackson, and nineteen I. W. W. delegates, who had been agitating among the miners at Bingham, were arrested. Large quantities of literature carried by these delegates to assist in promoting the strike at Bingham, were seized in raids on their homes and lodging places, and a printing establishment in Salt Lake City, where sundry literature was being printed, was likewise raided and the proprietor arrested. The I. W. W. could not hope to call out the miners at Park City or Eureka without first getting the Bingham miners to strike, according to Mr. Jackson, and with this in view they were launching their greatest efforts at Bingham. The agitators arrested will be prosecuted by the county attorney under the State syndicalism act.

The local assaying offices have announced a new price list for umpire assays, which averages about 30% over the former prices charged for such work. The assayers and chemists claim that, in many cases, labor and material costs have risen from 100 to 300%, and that they are compelled to make the increased charges.

BINGHAM.—Steady progress is being made in development at the property of the Bingham Tooele Mining Co. This property is situated in Middle canyon, seven miles from the International smelter at Tooele and about 1000 ft. from the mouth of the Utah Metals main tunnel. To the north and east of the thirteen claims owned by the company is the property of the Utah Metals Co.; to the south and west lie the Black Diamond and Midway groups, which were acquired by Jesse Knight last summer. The Bingham Tooele company is doing pioneer work in the hope of finding orebodies similar to those in the Bingham district. During the past year the adit, which is now in a distance of 1752 ft., has cut six different strata of lime. The first three were hard black lime, the next two were soft black lime, while the last is blue lime, much softer and more soluble than any cut previously. The quartzite also is softer, and the management is confident that an orebody will be found at the contact of the quartzite, or of the monozite dikes which cut the beds.

On May 2, about 100 miners at the Utah Apex were refused admission to the mine by V. S. Rood, superintendent. The men had been arriving late to work for several days, and Mr. Rood informed them that if they could not report on time, the mine would be closed until a new crew of miners was secured. The men state that they want eight hours from collar to collar, whereas the management insists that they enter and leave the mine on their own time. At last accounts, the men were gradually returning to work on the basis of the company's terms.

PARK CITY.—The latest departure at the Silver King Coalition mine is the use of diamond-drills to explore new ground. This was started several weeks ago, and is giving excellent results. A new fissure system is being developed which promises well. The King Coalition is said to be in better shape now than it has been for a number of years. The company has 200 men and is making a good production record, although it is not as large as the management would like, and at least 100 additional men could be used. The camp could easily use 500 men at the various mines if they were available. The milling plant of the King Coalition is being remodeled, and the first half is completed. This section is treating between 300 and 400 tons of ore per day. The management is considering the adoption of a flotation process to treat the fine.

TECOMA.—Conditions at the Tecoma Consolidated mine, near here, improve as progress is made; two headings are now being run. The main tunnel, called the 'Woodward', which will connect with the winze being sunk from the upper workings by the Utah Zinc Co., and at the same time intersect several veins at depth, is being driven steadily. The other heading, a drift from the Woodward tunnel, is being run on a good vein, which at last reports was three feet wide and averaged 30% lead and 8 oz. silver per ton. This drift intersected the fissure at a distance of 650 ft. from the portal. The face of the Woodward tunnel, which at present shows some

quartzite and iron pyrite, is approximately 800 ft. from the portal. At a distance of 900 ft. a raise will be put up to connect with the winze which is being sunk by the Utah Zinc Co. This latter company has a long-term lease upon the large zinc deposit blocked out in the old workings of the mine. As soon as this connection is made, shipments of zinc ore to the plant being constructed at Murray, Utah, will begin.

EUREKA.—During the first quarter of 1919, the Tintic Standard Mining Co.'s output totaled \$894,033. The value of the gross production to the end of 1919 was \$5,107,619, making the grand total up to April 1. of this year, \$6,001,652. Recent shipments from this property have been netting from \$6500 to \$8500 per lot of four standard cars. All of the ore so far shipped has come from the 1250 and 1350-ft. levels, in an area 700 ft. long by 400 wide. The 1450-ft. level is now being developed and the work so far done shows the ore to be equal in extent and value to that found on the two upper levels. Besides the straight shipping ore already developed, there is approximately 800,000 tons of milling ore proved up, for which the company is now constructing a concentrating plant. During the past few months, diamond-drilling operations from the No. 1 stope have prospected a copper deposit on the 1100-ft. level, and 28 ft. of ore that averages 6% copper and 17 to 22 oz. silver per ton has been penetrated. A drift is now being run to open this ore. No. 1 shaft has been deepened to the 1250-ft. level, and two drifts are being run from it to the east and south-east. Machinery has been ordered for the sinking of No. 3 shaft in the mineral channel, a distance of 1700 ft. north-easterly from No. 2. E. J. Raddatz, president, is of the opinion that it will take from three to five years to bring the property up to full production. At the present time its output is limited by shaft capacity, and when the No. 3 shaft is completed, the production can be increased.

BRITISH COLUMBIA

PREPARATIONS FOR A SEASON OF ACTIVE DEVELOPMENT.

STEWART.—Recent development on the L. L. & H. group of claims, situated on Bitter creek in Bear River valley, has exposed an orebody 27 ft. wide, according to C. N. Tubman, who, with E. M. Molander, one of the original stakers of the Mount Sicker properties on Vancouver Island, bonded this group last February from J. S. Hartley. The ore contains copper, silver, lead, and gold. When Messrs. Tubman and Molander went to work on March 14 they found that two tunnels had been driven, one for 40 ft. on the upper or galena lode and the other for 200 ft. on the lower or arsenical lode. The former cross-cut the lode and the latter had struck the vein and had been carried forward in ore for a distance of 17 ft. The L. L. H. is about 16 miles from Stewart and it is the intention to carry on development throughout the season now opening.

ALICE ARM.—Miners employed by the Taylor Mining Co. at the Dolly Varden mine left their work on April 22 and on May 3 are reported to be still on strike. Negotia-

tions are under way which, it is hoped, will result in the resumption of operations. As matters stand both the actual mining and the railroad, which furnishes transportation between tidewater and the mine, are tied up. The men's demands are for a raise in wages from a minimum of \$5 per day to \$6, single-cot bunks, scrubbing of camps, and free blankets and sheets. The company's rate of board is to remain at \$1.25 per day. This ultimatum was presented to the management, it being specified that three days would be allowed for a decision. It was announced that under no circumstances could the demands be allowed and that rather than submit the whole work-



THE MINING DISTRICTS OF SOUTH-WESTERN OREGON

would be permitted to cease. The men accordingly stopped work.

NELSON.—Rich samples of mineral have been taken from the upper workings of the Utica mine. They are from a vein between five and six feet wide and represent a rich stringer two feet wide, the latter being of gray copper with ruby and native silver, assaying from \$100 to \$1000 per ton. Mining of the entire lode should give ore containing 500 to 600 oz. of silver per ton.

CRANBROOK.—A. J. Palmquist, manager for the Wild Horse Creek Mining Co., who has been spending the winter in Texas, has returned to British Columbia and is making preparations for the resumption of placer mining on Perry creek. The company did preliminary work last season in the way of repairs to flumes and machinery so that washing operations should be started in the course of a month.

REVELSTOKE.—Recent development at the Lanark mine, an old and well-known property near here, appears to confirm the faith and judgment of the present owners, Fred. C. Elliott and William Dornberg. At a depth of 1000 ft. on their vein they have opened up a body of ore

containing a high-grade streak from two to four feet in width, with about six feet of milling ore. The high-grade averages 90 oz. silver and 65% lead. The vein has been drifted on for 30 ft. and holds its width and value. In addition it is asserted that a vein of high-grade gray copper has been exposed on which little work has been done. During the winter ore has been blocked and the Lanark now is ready to commence production. Since Messrs. Elliott and Dornberg have acquired control they have built a modern hydro-electric plant and a concentrator.

PRINCE RUPERT.—C. A. Banks, of the British-Canadian Silver Corporation, that recently acquired a large interest in the B. C. Silver Mines, Ltd., and the Bush Mines, Ltd., both in the Salmon River district, has gone to Stewart to plan the summer's development at the two properties. H. L. Batton, formerly with the Consolidated M. & S. Co., has been appointed manager at both properties. A considerable amount of diamond-drilling will be done. Burdie Brothers & Brett, Ltd., has taken an option on the American Boy group, at Nine-Mile mountain. The present shaft will be sunk to the 300-ft. level. R. H. Stewart, of Vancouver, is acting as consulting engineer to the firm. The tunnel at the Silver Standard mine, near Hazelton, has cut the No. 2 vein, exposing two feet of milling ore. The last 100 ft. of drifting has cut six stringers of solid sulphide ore, and it is probable that these will be developed when the tunnel has reached its objective, the main vein. Quite apart from its use as a working tunnel, the adit has been a success from an exploration point of view, as it has cut a number of rich stringers. A gasoline engine is being added to the mine equipment to supplement the water-power, which at times is inadequate.

A first payment of \$67,000 has been made by a syndicate of Vancouver men on the Silver Tip group, in the Salmon River district. Development will be started by R. Lacey as soon as weather conditions permit.

ONTARIO

NIPISSING SHAREHOLDERS PROTEST.

COBALT.—Shareholders of the Nipissing Mining Co., at the annual meeting, expressed the opinion that larger dividends should be paid. In support of this, they pointed to the surplus of \$4,372,952 as compared with \$1,980,126 in 1916. The increase of nearly a million and a half occurred during the three years in which the price of silver increased most rapidly. In reply, company officials pointed out that the greater part of the increase had been invested in Government bonds, which as a matter of principal they do not wish to sell at this time.

A. J. Young, president of the newly incorporated Bailey Silver Mines Co., has issued a statement in regard to the estimated earning power of the old Bailey-Cobalt mine as well as the Northern Customs Concentrator, both of which come under the ownership of the newly formed company. Mr. Young declares ore in sight contains 510,294 oz. of silver or an average of 22 oz. per ton. Costs of operation are placed at \$8 per ton, recovery at 85%, and daily tonnage at 50, and from this it is calculated that a net profit of \$768 daily may be realized. As regards the

newly acquired concentrator, this is already earning an average of about \$250 net profit daily, thus indicating a total earning power of \$1018 for both mine and mill. The estimate does not include probable ore and also omits the large tonnage of ore lying in the dumps. The British interests, owners and operators of the old Keeley mine in South Lorrain, have acquired an option on the adjoining Beaver Lake property. Two cash payments have already been made on the option price. The plan of the joint operation of the two properties is quite elaborate, and will include driving the main shaft to the contact at a depth of from 350 to 400 feet.

PORCUPINE.—At the Davidson the vein has been followed on the 500-ft. level for a distance of 460 ft. The width varies from 27 to 53 ft. of ore of a good grade. The present mill being only a small one designed for testing purposes, the building of a large modern mill with cyanide equipment is being considered. Plans are under way at the Gold Reef for sinking a shaft to develop orebodies indicated by diamond-drilling. The Clifton-Porcupine is drifting on the 200-ft. level, where the vein shows up equally well as on the 100-ft. level, and a good tonnage of ore is in sight. A drift has been started northward toward the basalt formation where the indications are regarded as favorable. The North Davidson, having secured funds for development on a large scale, has arranged for a supply of electric power and is erecting a mining plant and putting up camp buildings.

KIRKLAND LAKE.—The main shaft of the Ontario Kirkland is down 450 ft. When a sump is completed to the additional depth of 20 ft. a working station will be cut and cross-cutting undertaken to reach the orebodies developed on the 300-ft. level. One of these shows an average gold content of about \$20 for a distance of 100 ft., and the other averages about \$12. Unofficial estimates place the value of the ore opened up at about \$500,000. A mill is planned but definite steps toward it have been deferred until the results of development work at the 450-ft. level are known. The Kirkland Lake management has decided to drift toward the western boundary, operations hitherto having been largely confined to the eastern half of the property. The work will be at the 500-ft. level. The main shaft will be put down to 900 ft. At the Wood-Kirkland property in Lebel township a thorough exploration of the surface is being undertaken and test-pits will be driven on veins already found. The shaft of the Elliott-Kirkland will be continued from its present depth of 500 ft. to 700 ft. at which level lateral work will be carried to reach the porphyry-conglomerate contact, some little distance to the north. The Wright-Hargreaves is resuming operations, employing about 45 men. The workings have been unwatered and development will be pushed during the period of construction of the new mill.

SESEKINIK.—The Jensen farm, on which gold was discovered some years ago, has been taken over under option by Detroit interests and a company organized known as the Golden Summit. Two narrow veins were found on the surface, on which test-pits were sunk and at 18 ft. one of the veins had widened to two feet.



ALASKA

Juneau.—The Alaska Treadwell Gold Mining Co. has taken a bond on 12 gold-quartz claims at Nixon fork, near McGrath on the Kuskokwim river. An outfit costing, it is said, in the neighborhood of \$17,000, is being assembled here by the company for transportation to the Kuskokwim. A portable air-compressor, drilling-machines, and other equipment is included. Livingstone Wernecke, geologist for the Treadwell company, left for McGrath several weeks ago. He went to Seward and then traveled 12 days by dog team to his destination. His report on the claims is said to have been favorable and he was authorized to go to work. He has been working with a crew of 12 men ever since in opening up the prospects.

CALIFORNIA

Redding.—It is semi-officially stated that the Bully Hill company will erect extensive reduction works at Winthrop this summer. Preliminary topographic surveys for the buildings are being made. The options given by the Bully Hill Copper Mining & Smelting Co. to Walter Arnstein in January 1917 for the mines and the Sacramento Valley & Eastern railroad, extending from Pit on the Southern Pacific to the mines, were filed for record last week. Arnstein was to pay \$500,000 for the railroad, \$100,000 each year, and \$250,000 for the mines, 25% of the smelter proceeds on all ore extracted to be applied on the purchase price. A large amount of ore was treated under the option. It seems certain that the option has been taken up and that the Bully Hill Mines, Inc., the corporate successor of Mr. Arnstein, soon will become the owner of both railroad and mines.

COLORADO

Breckenridge.—A unique feature of the Royal Tiger Mines Co.'s operations is the recognition of the American family-man as an important factor in the economic success of mining enterprises. A married man's compensation is fifty cents per day more on most of the work than that of the single man. A first-class school, teaching all grades, is partly maintained by the company. A mercantile establishment, strictly co-operative, is backed by the company and on April 1 a refund of 10% to all the employees was made on their past purchases. The company is entering the productive stage, having a pilot-concentrator in operation and a 600-ton concentrator nearing completion.

Idaho Springs.—Lessees on the Freeman mine in Gilson gulch have opened up 2½ ft. of silver-lead ore with an average value of \$40 per ton. The property is one of the Silver Age group.—W. Krape and Denver associates operating the Hecla on Cavallo mountain have opened up gold ore assaying 9 oz. per ton. Shipments are now being prepared.—Bodies of milling ore are reported discovered on property of the Silver Mountain company in North Empire. A good tonnage awaits the opening of roads to ship ore to the mill.—The Newton and Hudson mills have resumed operations.

Mayday.—The Jumbo Mining Co. has purchased three claims from Thomas Hues, a prospector of this place, for a consideration of \$10,000. These claims join the Jumbo on

the south and it is said that the face of a drift in the workings near the Jumbo-Hues line shows good ore. Development work will be done here this summer.

NEVADA

Eureka.—The Ruby Hill Development Co. has just reached the water in its shaft after re-timbering the bad portion below the 900-ft. level.—The Holly shipped four cars of ore and is loading others. The railroad strike held up operations somewhat.—Lessees on the Holly Extension are taking out a little high-grade ore which they recently opened.

White Pine County.—H. Z. Peters, engineer for a newly formed company headed by R. G. Ward, has examined the Ward mine that adjoins the famous Eberhardt, one of the bonanza mines of Hamilton, considered to be the richest silver camp of the old days. It comprises 17 mining claims covering approximately 230 acres, part of which is patented ground. The deep Eberhardt tunnel that was driven nearly a mile into Treasure hill many years ago by the English company which owned the Eberhardt mine, runs within 300 ft. of the southerly end of the Ward mine and permission will be sought to work through this tunnel. In addition to 2000 tons of milling ore on the dump, there is estimated to be \$200,000 worth of ore blocked ready for stoping.

NEW MEXICO

Pinos Altos.—The new mill of the Calumet-New Mexico Mining Co. is doing well on the complex zinc-lead ores that it treats. One car of lead concentrate shipped to the smelter at El Paso sampled before shipping: 3.73 oz. gold, 25.25 oz. silver, 1.61% copper, and 52.0% lead.

OREGON

Gates.—We are informed that the Lotz-Larsen Mining Co. has opened a body of chalcopryite ore that assays 8.88% copper, 0.2 oz. gold, and 2.56 oz. silver. An adit 600 ft. long, driven the past winter, has followed ore all the way. The company controls 29 claims on which 3000 ft. of tunnel work has been done. Two cars of ore shipped assayed 10% copper with gold and silver worth \$7.80, and more will be shipped when the road is improved.

UTAH

San Juan County.—Leaching copper ores by means of sulphurous acid is to be tried at the Big Indian mine near La Salle. This property is owned by C. E. Loose and associates of Provo. It is estimated that approximately 300,000 tons of 3% copper ore is developed. The copper occurs in sandstone which is unusual. The mill now under course of construction is of 300 tons daily capacity. Construction has been under way since last summer and it now appears that the mill will be completed and ready for its initial run about the first of July. At present a crew of 15 to 25 men is employed. All of the iron tanks in which the leaching-solution is used have been lined with lead and all of the bearings which run in the solution are made of bronze. The ore is leached in a sulphurous acid solution, the solution being warmed by steam-pipes running through the tanks. The copper solution is then precipitated and the precipitates smelted into bullion.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. Mackintosh Bell is at Cobalt.

Seeley W. Mudd has gone to New York.

C. F. Nourse has gone to Eureka, Nevada.

James W. Neill came from Pasadena to San Francisco last Monday.

W. F. Rock, of Denver, has gone to Wassilla, Alaska, for six months.

J. L. Diller, of the U. S. Geological Survey, has been visiting Globe, Arizona.

R. S. Fitch has moved from Knob Noster, Missouri, to Leadville, Colorado.

R. F. McElvenney, manager of the Garfield smelter at Garfield, Utah, is in New York.

James A. Farrell, president of the United States Steel Corporation, is in San Francisco.

Harvey S. Mudd passed through San Francisco on his way from Los Angeles to Wallace, Idaho.

George D. Louderback, **A. Warner Lawson**, and **E. J. Schrader** were in Salt Lake City recently.

S. A. Holman, manager for the Balaklala Consolidated Copper Co., has returned to Coram, from Oakland.

George B. Agnew, president of the North Star Mines Co., is on a visit to the mine at Grass Valley, California.

F. A. Foster, Professor of Mechanical Engineering in the University of Peking, arrived in San Francisco last week.

Paul T. Bruhl, recently mill-superintendent for the American Venture & Mines Corporation, has gone to Honduras.

Cecil J. Brooks, metallurgist to the Simau Mining Co., of Benkoelen, Sumatra, sailed from San Francisco on May 7.

E. L. Young has been appointed assistant general manager for the Sunnyside Mining & Milling Co., at Eureka, Colorado.

C. Colcock Jones has returned to Los Angeles from mine examinations in the Yellow Pine mining district of Nevada.

William C. Madge is now engineer and assistant general manager to the Tintic Standard Mining Co., at Tintic, Utah.

Masaki Ito, chief engineer of the Besshi copper mine of the Sumitomo company, Japan, is visiting the Bisbee district.

Charles A. Mitke is in the Globe-Miami district, in connection with the ventilation of the Miami and Inspiration mines.

C. H. Desch has left the Royal Technical College of Glasgow to assume the chair of metallurgy in the University of Sheffield.

Lloyd C. White has returned to San Francisco from Shasta county, where he has been on one of his regular trips of inspection.

E. J. Mehren, editor of the 'Engineering News Record,' has gone to Europe to study conditions in England, France, and Germany.

E. L. Newhouse, Jr., and **S. M. Soupcoff**, of the Utah Department of A. S. & R. Co., are visiting various Nevada mining districts.

H. J. Glennon, formerly store-manager for the Moctezuma Copper Co. at Nacozari, Sonora, Mexico, has leased the Belen mine, south of Nacozari.

Kimio Hayashi, Chief of the Labor Department of the Furukawa Mining Co. of Japan, is making a three months visit to the United States for the purpose of studying labor

conditions. He spent several days in Utah and Montana recently.

Walter Larsh, underground superintendent for the Nevada Consolidated Copper Co., has been visiting the copper mines at Miami and Ray.

J. Nelson Nevius, of Pasadena, California, who has been incapacitated by illness for nearly a year, has recovered and is able to accept engagements.

Walter Gross, superintendent of the A. S. & R. Co.'s copper refinery at Perth Amboy, New Jersey, was in Utah recently, visiting the company's smelters.

D. C. Jackling left New York on May 8 on his return to San Francisco. He visited the Mesabi iron mines in Minnesota and the Butte & Superior at Butte.

C. E. Mills, former general manager for the Inspiration Con. Copper Co., spent several days during the latter part of April looking over the Inspiration property.

Charles L. Harrington is now at the Denver office of the Radium Company of Colorado. He was for the past two years mine superintendent at Naturita, Colorado.

William Rogers Wade has tendered his resignation as mine superintendent of the Pilares mine of the Moctezuma Copper Co., at Nacozari, Sonora, Mexico. He is now in New York.

Frank Ayers, who recently received his discharge from the U. S. Army, has been appointed mine superintendent of the Pilares mine of the Moctezuma Copper Co. at Nacozari, Mexico.

Joseph T. Singewald, Jr., Professor of Economic Geology in the Johns Hopkins University, who has been engaged in geologic investigations in Peru during the past five months, has returned to Baltimore.

Gerard De Geer, superintendent of the open-hearth and electric steel-furnace department of the Stora Kopparbergs Bergslags, in Sweden, is making a tour through the United States. He was in Utah recently.

Obituary

John Christy, mining engineer of Clifton, died at Gila Bend, on April 14. He was well known in mining circles both in the Clifton-Morenci and the Globe-Miami districts, and was equally prominent in political circles, having been a former member of the Arizona State Legislature.

Edward O. Kennedy, a pioneer in the Globe district, died on April 25, at the age of 83 years, in St. Joseph's hospital, Phoenix, Arizona. He was born in New York, but went to Colorado in the early '60s. A few years afterward he went to Silver City, New Mexico, and in the fall of 1876 he went to Globe, where he was superintendent of the first Old Dominion smelter, a few miles west of Globe. He also had charge of the Stonewall Jackson mill at McMillen for a time, and built and operated the first custom smelter in the Globe district.

FIRST ANNUAL CALIFORNIA MINE-RESCUE AND FIRST-AID CONTEST

University of California, Berkeley, May 8, 1920
Mine-Rescue Contest

Teams	%
University of California	94½
Stanford University	91½
Empire Mines (Empire shaft)	96½
Empire Mines (Pennsylvania shaft)	93½
First-Aid Contest	
University of California	93½
Stanford University	91
Empire Mines (Empire shaft)	97½
Empire Mines (Pennsylvania shaft)	95½

THE METAL MARKET



METAL PRICES

San Francisco, May 11

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	11
Copper, electrolytic, cents per pound.....	10.25
Lead, pig, cents per pound.....	8 75-9 75
Platinum, pure, per ounce.....	\$115
Platinum, 10% iridium, per ounce.....	\$155
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	10
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

May 10.—Copper is quiet and slightly easier. Lead is inactive and lower. Zinc is stagnant and soft.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 48.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

New York		London	Average week ending	
Date	cents	pence		Pence
May 4.....	109.50	65.50	Mch. 29.....	125.81
" 5.....	107.50	63.50	Apr. 5.....	126.50
" 6.....	105.50	62.25	" 12.....	123.75
" 7.....	102.25	60.00	" 19.....	118.12
" 8.....	104.25	61.62	" 26.....	117.67
" 9 Sunday.....			May 3.....	112.08
" 10.....	104.00	61.50	" 10.....	105.50

Monthly averages

1918		1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.82	100.30
Feb.	85.79	111.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92
Apr.	95.35	101.12	118.68	Oct.	101.12	119.10
May	89.50	107.23	.....	Nov.	101.12	127.57
June	89.50	110.50	.....	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

New York		Average week ending	
Date	cents		
May 4.....	19.25	Mch. 29.....	18.00
" 5.....	19.25	Apr. 5.....	19.10
" 6.....	19.25	" 12.....	19.25
" 7.....	19.00	" 19.....	19.25
" 8.....	19.00	" 26.....	19.21
" 9 Sunday.....		May 3.....	19.25
" 10.....	19.00	" 10.....	19.12

Monthly averages

1918		1919	1920	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66
May	23.50	15.91	.....	Nov.	26.00	20.45
June	23.50	17.53	.....	Dec.	26.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

New York		Average week ending	
Date	cents		
May 4.....	8.75	Mch. 29.....	8.96
" 5.....	8.75	Apr. 5.....	8.92
" 6.....	8.75	" 12.....	8.78
" 7.....	8.50	" 19.....	8.71
" 8.....	8.50	" 26.....	8.77
" 9 Sunday.....		May 3.....	8.75
" 10.....	8.50	" 10.....	8.82

Monthly averages

1918		1919	1920	1918	1919	1920
Jan.	8.55	5.90	8.65	July	8.03	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40
May	6.88	5.04	.....	Nov.	8.05	6.76
June	7.59	5.32	.....	Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Monthly averages		1918	1919	1920	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	.....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	.....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	.....
Apr.	85.53	72.50	62.12	Oct.	78.82	54.82	.....
May	100.01	72.50	.....	Nov.	73.87	54.17	.....
June	81.00	71.83	.....	Dec.	71.52	54.94	.....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date				Average week ending	
May 4.....	8.20			Mch. 29.....	8.87
" 5.....	8.20			Apr. 5.....	8.91
" 6.....	8.20			" 12.....	9.17
" 7.....	8.20			" 19.....	8.94
" 8.....	8.20			" 26.....	8.37
" 9 Sunday.....				May 3.....	8.32
" 10.....	8.15			" 10.....	8.21

Monthly averages

1918		1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.58	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82
May	7.62	6.43	.....	Nov.	8.75	8.12
June	7.92	6.91	.....	Dec.	8.49	8.09

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920	1918	1919	1920
Apr. 13.....	100.00	100.00	100.00	Apr. 27.....	97.00	97.00
" 20.....	100.00	100.00	100.00	May 4.....	97.00	85.00

Monthly averages

1918		1919	1920	1918	1919	1920
Jan.	128.08	103.75	89.00	July	120.00	100.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00
May	110.00	84.80	.....	Nov.	120.00	78.00
June	112.00	94.40	.....	Dec.	115.00	95.00

SENATE HEARING ON THE COAL INDUSTRY

Seasonal rates on coal as a means of equalizing production and distribution to avoid famines caused by strikes or bad weather were endorsed as in the public interest by Interstate Commerce Commissioner Clark and Director Smith of the U. S. Geological Survey in testimony before the Senate Coal Committee. George H. Cushing, Director Wholesale Coal Association; George Heaps, representing Iowa Coal Operators Association; and C. E. Leshar, editor of the "Coal Age", formerly of the Geological Survey, while favoring the end desired, opposed seasonal rates as being impracticable.

Senator Frelinghuysen declared the public has exhausted its patience over high coal prices and inability to get coal when most needed, and insisted that Congress must "put its arm around the industry", and predicted that it would do so "in twelve months". Hearings point to probable centralization of authority over coal in Interior Department under an assistant secretary, whom the Senator says must be a man of vision and of leadership capable of treating with operators, miners, and the public on problems involving labor, storage, transportation, and prices. The Senator expressed impatience over opposition to plans designed to provide the country with an adequate supply of coal at all times, declaring that "the same people who appealed for assistance last winter are now opposing measures drafted as a result of those experiences and intended for their relief".

Director Smith declared that to allow present conditions to continue was to invite industrial paralysis. The mines and railroads must handle more coal in the summer to relieve the heavy burden of fall and winter. At present from 35 to 60% more coal is mined in November, the highest producing month, than in April, the lowest. The coal business would be helped and miners, operators, and consumers benefited by surer supplies of cheaper coal.

Commissioner Clark said the Commission unanimously favored seasonal rates. The bituminous industry was over-developed. Present situation resulted in congestion of terminals because of the re-consignment practice. He favored reductions in rates in cents per ton rather than on the percentage basis. Seasonal rates would reduce prices for coal due to resulting competition. With a perfect car service prices would drop in a week and result in a production 40% greater than the demand. The Commission did not have power to prescribe seasonal rates.

Mr. Cushing said changes in rates must come through evolution rather than revolution. Equal monthly production and consumption of coal would involve a storage program contrary to business tendencies and difficult of realization. He said coal mining was intermingled closely with farming and 100,000 coal miners are required in farming and industrial work in the off-season. Storage could not be induced in summer, as the industrial program was not known until after the final crop report about July 15. Storage in large cities was difficult because of lack of space and coal could not be stored in buildings on account of fire-risk and it was more valuable for other commercial uses than storage of coal. Coal stored under water would probably be frozen when it was needed. He thought there were about 3000 too many coal mines and suggested government regulations of the number of mines as a possible remedy. He said that seasonal rates might apply on anthracite coal, as it was mainly for household use and was capable of storage.

MONEY AND EXCHANGE

Foreign quotations on May 11 are as follows:		
Sterling, dollars:	Cable	3.86½
	Demand	3.85½
Francs, cents:	Cable	6.61
	Demand	6.60
Lire, cents:	Demand	5.06½
Marks, cents	.....	2.03

Eastern Metal Market

New York, May 5.

All the markets are inactive and are still suffering from the effects of the railroad and other strikes. Prices are fairly steady in most cases.

The copper market is inactive but steady. Stocks are gradually growing less and some refineries are closed.

The tin market continues quiet. There is some interest by consumers in future shipments but features are absent.

But little change is noticeable in the local market for lead and prices are steady.

Demand for zinc is very light but prices are fairly steady. Antimony is lower and inactive.

IRON AND STEEL

Considering the industry as a whole, railroad shipments of iron and steel have improved, says 'The Iron Age'. The exception is the Pittsburgh district and the Valleys. Much of the betterment is due to concentration on routing and on making up solid trains, for the return and replacement of railroad labor is proceeding slowly. While some plants are operating at 80% capacity others are not above 20%.

The closing of the gap between the Steel Corporation prices and those of the independents is shown in Chicago district sales. Plates have been sold for last-half delivery at 3c., Pittsburgh; quotations of 3.25c., 3c., and 2.75c., Pittsburgh, are reported commoner on shapes and a minimum of 3c. has been named by Eastern independent producers on bars, with 2.75c. in exceptional cases.

COPPER

An announcement of interest is the definite arrangement, concluded on Monday, for financing purchases of American copper by France. This has been in the air for some time as well as a like plan for other countries. Purchases by France, Germany, England, and other foreign countries continue of fair proportions. Exports of copper to Germany last week were 2782 tons out of a total of 5760, Great Britain being second with 2283 tons. The domestic market is still inactive with prices largely nominal. Leading producers continue firmly to maintain quotations for Lake and electrolytic copper at 19.25c., New York, for early delivery. For third-quarter they ask in some cases 19.50c., but very little business is reported. The outside market still exists at around 18.50 to 18.75c., New York, for electrolytic for May and June, but almost no business is recorded. The future of the market is hard to predict because of the fact that some large refineries have been obliged to close on account of the railroad, mines, and other strikes. This will at least delay deliveries on contracts, particularly by those who have their copper refined on toll.

TIN

The market is featureless and quiet but less erratic. Labor conditions continue to depress. This, together with the transportation mix-up, and the car shortage, has caused consumers to stay out of the market. There has been therefore but little buying of any kind. On Friday last about 150 tons of future shipments was sold on the Metal Exchange at 59.62½ to 60c., depending on the position. Consumers are showing some interest in future shipments and there is stated to be a dormant inquiry of proportions which may develop into business any day. Quotations for spot Straits have been steady the past week at around 61c., New York, and the quotation yesterday was 60.25c., New York. Deliveries into consumption in April are returned as 3305 tons, of which only 605 tons was credited to Pacific ports. The quantity in stocks and landing on April 30 was 2676 tons. Tin imports to May 1 have been 16,783 tons as compared with 6341 tons to May 1, 1919. The arrivals thus

far in May have been 1380 tons, with 1741 tons reported afloat.

ZINC

The market continues in its lifeless condition. There have been no features, but quotations, while soft, have been fairly steady. Prime Western for early delivery and for shipment into July is quoted at 7.95c., St. Louis, or 8.35c., New York, with very little interest either by producers or consumers. The effect of the railroad demoralization is still apparent, though shipments out of St. Louis are reported as nearly normal. There is no desire by producers to sell at present levels and they are confident of higher prices later. The British market still is a factor, though sales by exporters for re-purchases on the other side have diminished.

LEAD

There has been very little change except that the cheap offerings, referred to last week, seem to have stopped; this has caused a steadier market. There have been further sales of spot, New York, up to 9.37½c. The quotation of the American Smelting & Refining Co. continues unchanged at 9c., St. Louis, or 9.25c., New York, while that of the outside market for early delivery is 8.40c., St. Louis, or 8.75c., New York. Shipments from the West are still more or less tied up because of strikes, and all sales made are subject to strikes and embargoes.

ANTIMONY

There is very little interest in the market and prices for ordinary grades are around 10 to 10.25c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The virgin metal, 98 to 99% pure, can be bought at 33c., New York, from the leading interests or at 31.50c., New York, from independent sellers in wholesale lots for early delivery.

ORES

Tungsten: There has been no change and prices are largely nominal but firm at \$7 to \$15 per unit in 60% concentrate. The market is still awaiting the tariff settlement.

Ferro-tungsten and tungsten powder are quoted at 85c. to \$1.15 per lb. of contained tungsten. British and French alloy is being freely offered, but some of it contains copper, which is unacceptable to certain consumers.

Molybdenum: The market is inactive and prices are unchanged at around 75c. per lb. of MoS₂ in 90% concentrate.

Manganese: No sales are recorded, but quotations appear to be unchanged at 65 to 80c. per unit, seaboard, for high-grade foreign ore, depending on delivery. Imports in March are reported as 18,970 tons, bringing the total for the nine months ended April 1 to 151,098 tons as compared with 431,718 tons for the same nine months in 1919.

Manganese-Iron Alloys: Ferro-manganese is quiet with a fair inquiry for delivery before July 1, but little for the last half. Quotations are unchanged and firm at \$200, delivered, for the last half and \$250, delivered, for early delivery of domestic alloy. A little British alloy can be bought at \$195, seaboard, for last half and at \$225 to \$250 for delivery before July 1. Spiegeleisen is quiet but strong at \$75, furnace, with domestic sales up to 600 tons recorded. There is a moderate foreign inquiry, which the high prices may hinder from developing into business.

Imports of ferro-manganese in March were 2860 tons, making the total for the nine months ended March 31, 26,280 tons as against 17,905 tons for the same nine months in 1919.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	*Latest dividends—	
						Date	Per share
Ahmek, Michigan	copper	200,000	\$25.00	\$100,000	\$11,950,000	Mar. 31, 1920	\$0.50
Allouez, Michigan	copper	100,000	25.00		2,850,000	Mar. 31, 1919	1.00
American S. & R., U. S. and Mex.	c.i.g.s.s.	(400,980 (com.)	100.00	600,080	113,697,045	Mar. 15, 1920	1.00
		(183,120 (pfd.)	25.00		875,000	Mar. 15, 1920	1.75
Am. Z. L. & S., Missouri and Tenn.	c.i.z.s.g.	(98,560 (pfd.)	25.00	144,840	5,758,400	Feb. 1, 1920	1.50
Anaconda, Montana	c.z.s.g.	2,331,250	50.00	2,331,250	167,770,375	Feb. 20, 1920	1.00
Angelaut, California	gold	200,000	5.00		1,970,000	Dec. 25, 1919	0.05
Atolia, California	tungsten	100,000	1.00		5,204,500	Dec. 14, 1918	0.50
Arizona, Arizona	copper	(1,519,800	5s.	227,000	2,713,728	Aug. 31, 1919	0.18
		(2316,530	75 pfd.	53,840	21,486,004	Nov. 21, 1919	...
Arizona Commercial, Arizona	c.s.g.	265,000	5.00		1,080,500	Oct. 31, 1918	0.50
Barnes King, Montana	gold	400,000	5.00	20,000	400,000	Feb. 15, 1920	0.05
Bingham Mines, Utah	l.s.g.	150,000	10.00		600,000	Sept. 30, 1919	0.25
Bunker Hill & Sullivan, Idaho	l.s.	327,000	10.00	245,250	24,048,750	Mar. 1, 1920	0.25
Butte & Superior, Montana	z.s.l.	290,184	10.00		16,940,258	Sept. 1, 1917	1.25
Butte Copper & Zinc, Montana	z.s.l.mn.	411,700	5.00		205,800	July 30, 1918	0.50
Caledonia, Idaho	l.s.	2,605,000	1.00	78,150	4,099,006	Mar. 5, 1920	0.01
Calumet & Arizona, Arizona	copper	642,521	10.00	642,521	43,702,008	Mar. 22, 1920	1.00
Calumet & Hecla, Michigan	copper	100,000	25.00		151,750,000	Dec. 31, 1919	5.00
Centennial, Michigan	copper	90,000	25.00		360,000	Dec. 31, 1918	1.00
Cerro Gordo, California	l.z.s.	1,000,000	1.00		300,000	Jan. 15, 1918	0.05
Champion, Michigan	copper	100,000	25.00		25,250,261	Dec. 15, 1919	0.40
Chief Con., Utah	l.z.s.g.c.	884,232	1.00	88,423	1,606,248	Feb. 2, 1919	0.10
Chino, New Mexico	copper	869,080	5.00		29,339,225	Mar. 31, 1920	0.37 1/2
Columbus-Rexall, Utah	c.s.g.	586,234	1.00		14,600	Jan. 15, 1919	0.02 1/2
Con. Arizona Smelting, Arizona	c.s.s.	1,063,000	5.00		498,000	Dec. 17, 1918	0.05
Con. Interstate-Cullahan, Idaho	z.l.s.	325,000	10.00	186,652	7,152,734	Mar. 30, 1920	0.50
Copper Range, Michigan	copper	305,000	25.00	197,207	26,603,926	Mar. 15, 1920	0.50
Cresson, Colorado	gold	1,220,000	1.00	122,000	8,491,163	Mar. 10, 1920	0.10
Daly, Utah	l.s.g.	150,000	20.00	15,000	3,157,500	Jan. 2, 1920	0.10
Davis-Daly, Montana	copper	600,000	10.00	150,000	900,000	Mar. 20, 1920	0.25
Dragon Con., Utah	c.i.s.g.	1,875,000	1.00	18,750	187,500	Jan. 25, 1920	0.01
Ducktown, Tennessee	copper	198,000	4.80		2,678,702	May 1917	0.96
Eagle & Blue Bell, Utah	l.c.z.s.	893,146	1.00		1,250,405	Sept. 1919	0.05
East Butte, Montana	copper	421,849	10.00		1,687,396	Dec. 31, 1919	0.50
Electric Point, Washington	lead	793,750	1.00		301,625	Dec. 22, 1919	0.03
Empire, Idaho	copper	1,000,000	1.00		880,000	July 1, 1918	0.05
Engels, California	copper	1,791,926	1.00		565,273	Oct. 1, 1918	0.01 1/2
Federal M. & S., Idaho	l.z.s.	pfd. 120,000	100.00	89,896	15,094,246	Mar. 15, 1920	0.75
First National Copper Co., Cal.	copper	600,000	5.00		680,000	Feb. 25, 1919	0.15
General Development, U. S.	...	120,000	25.00		4,913,917	Sept. 3, 1918	1.00
Golden Cycle, Colorado	gold	1,500,000	1.00	135,000	9,373,500	Mar. 10, 1920	0.30
Goldfield Con. Mines, Nevada	gold	3,559,148	10.00		29,177,700	Dec. 31, 1919	0.05
Grand Central, Utah	l.s.	600,000	1.00		1,858,000	Dec. 23, 1919	0.02
Hecla, Idaho	l.s.	1,000,000	0.25	150,000	8,005,000	Mar. 28, 1920	0.15
Homestake, South Dakota	gold	251,160	100.00		43,050,244	Sept. 25, 1919	0.50
Inspiration, Arizona	copper	1,181,967	20.00	1,772,951	34,846,817	Jan. 26, 1920	1.50
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	25,000	3,550,000	Jan. 26, 1920	0.02 1/2
Iron Cap, Arizona	copper	142,100	10.00	35,525	996,303	Mar. 18, 1920	0.25
Iso Royale, Michigan	copper	150,000	25.00		2,025,000	Sept. 30, 1919	0.50
Jim Butler, Nevada	s.g.	1,718,021	1.00		1,151,074	Aug. 1, 1918	0.07
Judge M. & S., Utah	l.z.s.g.s.	480,000	1.00		2,370,000	April 1, 1919	0.12 1/2
Kennecott, Alaska	copper	2,786,679	5.00	1,393,339	49,323,597	Mar. 20, 1920	0.50
Liberty Bell, Colorado	gold	133,560	5.00	26,712	2,687,670	Mar. 31, 1920	0.02
Lucky Tiger, Sonora, Mexico	g.s.	715,337	10.00	257,521	6,403,721	Mar. 20, 1920	0.12
Magma, Arizona	copper	240,000	5.00		1,704,000	Jan. 6, 1919	1.00
Mass Con., Michigan	copper	100,000	25.00		500,000	Nov. 15, 1917	1.00
Miami Copper Co., Arizona	copper	747,114	5.00	373,552	21,836,381	Feb. 15, 1920	0.50
Mohawk, Michigan	copper	100,000	25.00	150,000	9,275,000	Feb. 1, 1920	1.50
Nevada Con., Nevada	copper	1,999,457	5.00	499,864	45,768,888	Mar. 31, 1920	0.25
Nevada Packard, Nevada	silver	1,164,492	1.00		110,627	April 20, 1919	0.02
Nevada Wonder, Nevada	s.g.	1,500,000	1.00		1,519,005	May 21, 1919	0.05
New Cornelia, Arizona	copper	1,800,000	5.00		450,000	Nov. 25, 1918	0.25
New Idria, California	quicksilver	100,000	5.00		2,705,000	Jan. 1, 1919	0.25
New Jersey Zinc, New Jersey	zinc	350,000	100.00	1,400,000	2,100,000	Feb. 10, 1920	4.00
North Butte, Montana	c.s.g.	430,000	15.00		14,657,000	Oct. 28, 1918	0.25
North Star, California	gold	250,000	10.00		5,537,040	June 28, 1919	0.40
Old Dominion, Arizona	c.s.g.	297,071	25.00		14,405,260	Dec. 31, 1918	1.00
Ontario Silver, Utah	s.l.	150,000	100.00		14,157,500	Jan. 4, 1919	0.50
Osceola, Michigan	copper	96,150	25.00	49,075	17,709,300	Mar. 31, 1920	0.50
P Phelps Dodge, Ariz., N. Mex., Mex.	c.s.g.	450,000	100.00	1,125,000	85,721,527	Jan. 2, 1920	2.50
Portland, Colorado	gold	3,000,000	1.00	60,000	11,557,080	Jan. 20, 1920	0.02
Quincy, Michigan	copper	110,000	25.00	110,000	27,002,500	Mar. 29, 1920	1.00
Ray Con., Arizona	copper	1,577,179	10.00	394,295	24,329,725	Mar. 31, 1920	0.25
Rochester Mines, Nevada	s.g.	2,210,591	1.00		88,064	Oct. 1, 1918	0.02 1/2
Shannon, Arizona	copper	300,000	10.00		1,425,000	Nov. 15, 1917	0.25
Shattuck, Arizona	c.i.s.g.	350,000	10.00	87,500	7,810,500	Jan. 30, 1920	0.25
Silver King Coalition, Utah	l.s.	1,250,000	5.00		15,198,560	Jan. 1, 1918	0.15
Silver King Con., Utah	l.s.c.g.	850,537	1.00		1,562,705	April 1, 1918	0.10
St. Joseph Lead, Missouri	lead	1,409,466	10.00	704,733	19,570,374	Mar. 20, 1920	0.50
Tamarack & Custer, Idaho	l.s.	1,778,500	1.00		461,830	Aug. 27, 1918	0.06
Tennessee Copper, Tennessee	copper and acid	391,498	no par value		392,817	May 15, 1918	1.00
Tintic Standard, Utah	l.s.	1,174,500	1.00	117,320	1,068,452	Mar. 29, 1920	0.10
Tomboy, Colorado	g.s.	310,000	£1		4,074,200	June 28, 1918	0.12
Tom Reed, Arizona	gold	909,555	1.00	54,573	2,810,535	Mar. 20, 1920	0.02

*These figures include dividends payable on or before March 31, 1920.

Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	Latest dividends	
						Date	Per share
Tonopah Belmont Dev., Nevada...	s.g.	1,500,000	1.00	75,000	10,118,063	Jan. 1, 1920.....	0.05
Tonopah Extension, Nevada.....	s.g.	1,282,801	1.00	.....	2,361,379	Oct. 1, 1919.....	0.10
Tonopah Mining, Nevada.....	s.g.	1,000,000	1.00	.....	14,875,000	Nov. 21, 1919.....	0.15
United Eastern, Arizona.....	gold	1,383,000	1.00	286,230	2,439,770	Jan. 25, 1920.....	0.21
U. S. S. R. & M., U. S., Mexico....	l.z.c.s.g.	com. 351,115 pfd. 486,350	50.00	526,672	12,735,760	Jan. 15, 1920.....	1.50
United Verde Copper, Arizona.....	copper	300,000	no par value	425,556	23,604,598	Jan. 15, 1920.....	0.87½
United Verde Extension, Arizona..	copper	1,050,000	0.50	450,000	53,297,000	Mch. 10, 1920.....	1.50
Utah Apex, Utah.....	c.l.s.g.	528,200	5.00	525,000	11,655,000	Feb. 1, 1920.....	0.50
Utah Con., Utah.....	c.l.s.g.	300,000	5.00	.....	1,122,425	Nov. 11, 1918.....	0.25
Utah Copper, Utah.....	copper	1,624,490	10.00	.....	12,810,000	Mch. 25, 1919.....	0.25
Utah Metal, Utah.....	l.c.s.g.	691,588	1.00	2,436,735	104,199,457	Mch. 31, 1920.....	1.50
Vindicator Con., Colorado.....	gold	1,500,000	1.00	.....	895,734	Dec. 10, 1917.....	0.30
Wellington Mines, Colorado.....	l.z.	1,000,000	1.00	15,000	3,847,500	Jan. 24, 1920.....	0.01
West End, Nevada.....	s.g.	1,788,486	5.00	.....	1,950,000	Jan. 2, 1919.....	0.10
Wolverine, Michigan.....	copper	60,000	25.00	.....	1,251,940	Dec. 9, 1919.....	0.05
Yellow Pine, Nevada.....	z.l.	1,000,000	1.00	30,000	10,250,000	Jan. 2, 1920.....	0.50
Yukon Gold, Alaska, Cal., Nev....	gold	3,500,000	5.00	.....	2,533,008	Mch. 30, 1920.....	0.03
				.....	9,858,110	June 1918.....	0.02½

CANADA

Belmont Surf Inlet, British Columbia	g.c.	2,500,000	1.00	.....	250,000	July 1, 1919.....	0.05
Buffalo, Ontario.....	silver	500,000	1.00	.....	3,287,000	Aug. 10, 1918.....	0.25
Coniagas, Ontario.....	silver	800,000	5.00	100,000	9,740,000	Feb. 1, 1920.....	0.12½
Con. M. & S., British Columbia...	l.c.s.g.	419,098	25.00	263,343	6,309,589	Jan. 2, 1920.....	0.62½
Crown Reserve, British Columbia.	silver	2,000,000	1.00	.....	6,200,000	Jan. 15, 1917.....	0.05
Florence, British Columbia.....	l.s.z.	1,100,000	1.00	.....	35,300	April 20, 1919.....	0.01½
Granby Con. M. S. & P. B. C.....	c.s.g.	150,004	100.00	.....	10,339,352	May 1, 1919.....	1.25
Hedley, British Columbia.....	gold	240,000	10.00	.....	2,460,000	June 30, 1919.....	0.10
Hollinger, Ontario.....	gold	4,920,000	5.00	246,000	11,392,000	Feb. 25, 1920.....	0.05
Howe Sound, B. C. and Mexico....	copper	1,984,150	1.00	99,208	793,661	Jan. 15, 1919.....	0.05
International Nickel, Ontario.....	n.c.	com. 1,673,384 pfd. 89,126	25.00 100.00	.....	52,276,984	Dec. 1, 1918.....	1.00
Kerr Lake, Ontario.....	silver	600,000	4.00	133,689	7,620,159	Feb. 1, 1920.....	1.50
Lake Shore, Ontario.....	gold	2,000,000	1.00	.....	8,910,000	Sept. 22, 1919.....	1.00+
McKinley-Darragh, Ontario.....	silver	2,247,692	1.00	.....	200,000	Oct. 25, 1919.....	0.02½
McIntyre, Ontario.....	gold	3,640,283	1.00	67,431	5,821,522	Jan. 1, 1920.....	0.03
Mining Corp., Ontario.....	silver	1,660,050	5.00	182,014	1,630,627	Jan. 2, 1920.....	0.05
Nipissing, Ontario.....	silver	1,200,000	5.00	.....	6,528,616*	Sept. 16, 1919.....	0.12½
Porcupine Crown, Ontario.....	silver	2,000,000	1.00	600,000	21,240,000	Jan. 20, 1920.....	0.50
Rambler-Cariboo, British Columbia.	l.z.s.	1,750,000	1.00	.....	840,000	June 1, 1917.....	0.06
Standard, British Columbia.....	l.z.s.	2,000,000	1.00	.....	560,000	Feb. 15, 1919.....	0.01
Temiskaming, Ontario.....	silver	2,500,000	1.00	.....	2,700,000	Oct. 15, 1917.....	0.05
Tough-Oakes, Ontario.....	gold	531,500	5.00	100,000	2,225,000	Jan. 31, 1920.....	0.04
Trethewey, Ontario.....	silver	1,000,000	1.00	.....	398,825	Jan. 15, 1917.....	0.12½
				.....	1,211,999	Jan. 2, 1919.....	0.05

*Of this sum, \$1,652,260 was paid by the individual companies prior to their amalgamation in 1914.

†This is a capital distribution, and reduces the par value of the stock from \$5 to \$4, corresponding to a reduction in total capitalization from \$3,000,000 to \$2,400,000.

Company Reports

RAY CONSOLIDATED COPPER CO.

Report for the year ended December 31, 1919.

Property: mine, mill, and railway at Ray, Arizona.

Operating Officials: L. S. Cates, general manager; W. S. Boyd, manager; C. A. Smith, superintendent of mines; D. D. Moffat, superintendent of mills.

Financial Statement: operating revenue from copper, gold, and silver sold, \$8,252,505; operating expense, \$7,185,986. Net income from operations plus depletion, \$1,066,519. Miscellaneous income, \$300,124. Balance on December 31, 1919, \$14,929,732.

Dividends: during 1919 \$3,154,358; total to date, \$23,835,441.

Development: owing to curtailment of production during the year, development was also limited, the total for the year consisting of 31,079 ft., as compared with 61,711 ft. for the year 1918. At No. 1 shaft 11,275 ft. was driven as compared with 26,870 ft. for the previous year; at No. 2 shaft, 19,328 ft. as compared with 34,293 ft.; at No. 3 shaft, 476 ft. as compared with 548 ft. The total development since the beginning of operations to the end of the year 1919 was 742,093 ft., or approximately 140.5 miles. Mining operations to the same date have destroyed 397,954 ft., and there remains intact 344,139 ft. or approximately 65 miles. The total ore-reserves on December 31, 1919, were 84,736,384 tons, averaging 2.063% copper. These reserves were not recalculated at the end of the year but were obtained by deducting the tonnage mined during the year from the ore-reserves reported at the end of the previous year.

Production: the total ore milled for the year was 1,621,600 dry tons, corresponding to a daily average of 4443 tons, as compared with 3,411,000 dry tons during 1918. The

average grade of the ore milled for 1919 was 1.814% copper as compared with 1.613% for 1918. The average recovery was 79.45% of the entire copper content, equivalent to 28.83 lb. of copper per ton. The gross production of copper was 46,746,893 lb. in concentrates, and 724,429 lb. in smelting ore.

CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.

Report for the year ended December 31, 1919.

Property: mine and mill in the Coeur d'Alene district.

Operating Officials: C. W. Newton, mine manager; D. F. Haley, consulting engineer.

Financial Statement: income from 4½ months production, \$487,303; miscellaneous income, \$6960; proceeds from sale of stocks and bonds, \$478,401; total, \$972,665. Cost of mining and royalties, \$447,929; general expense, \$51,579; improvements and maintenance, \$103,394. Surplus for the year, \$369,763.

Dividends: none during 1919; total to date, \$6,966,082.

Development: during the period from March 1 to October 15, while mining and shipping operations were suspended, the company carried on extensive development work, with the result that the most important discovery on the Interstate-Callahan in recent times was made. Ore was found in a cross-cut north of the 500-ft. level, which consists of a large body of high-grade, assaying as high as 34% lead, 31% zinc, and 7 oz. of silver per ton. The new orebody is identical with the big vein that has made the mine one of the largest producers of zinc-lead in the United States. The orebody has widened out with further development from 2 ft. to 32½ feet.

Production: 67,952 tons of ore was mined and 52,526 tons was milled with an average content of 2.57 oz. silver, 7.73% lead, and 17.17% zinc.

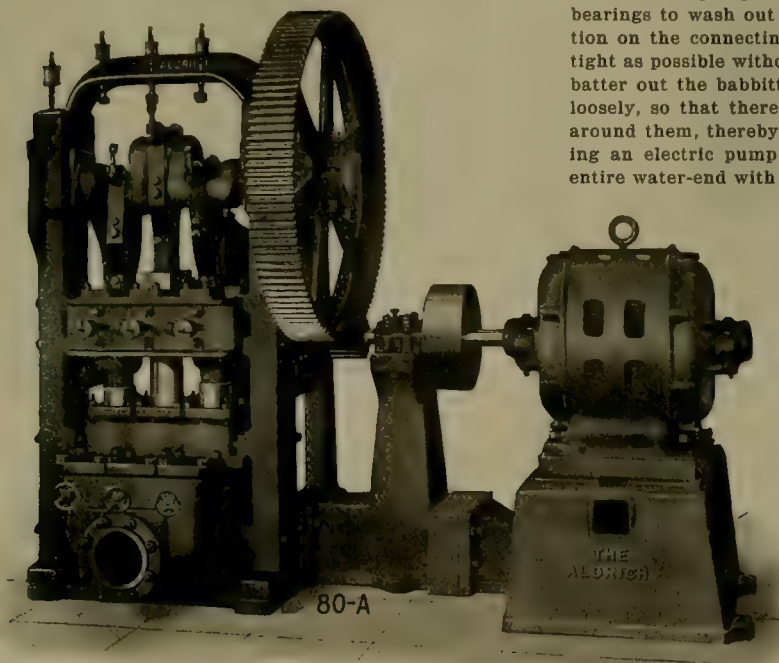
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

'YDRANGE' PUMPS

After a pump has been installed it frequently happens that a change in conditions makes it desirable to have a pump of greater capacity or for greater working lift, and it is with such conditions in view that the Aldrich Pump Co. has developed the 'ydrange' type of machine. The accompanying illustration shows a vertical triplex pump of this kind directly geared through a flexible coupling to an electric motor. Following are the outstanding features of this style of pump.

1. The valves are arranged to work satisfactorily at a



Aldrich 'Ydrange' Triplex Pump

machine of more than ordinary value. The pump is sectional, having its standards, main journals, plunger guides, cross-heads, etc., separate, which facilitates handling. As many parts as possible are made alike and interchangeable, simplifying the matter of repair parts. This construction produces a very compact and simple machine, with accessibility of working parts always a prominent feature. These pumps are suitable for general pumping requirements as encountered about mills, mines, and quarries.

Proper operation is an important factor in getting the best results from any pumping equipment.

When the pump is first started, use plenty of oil on the bearings to wash out any dirt or dust, take up the lost motion on the connecting rods and main journals, and run as tight as possible without heating. Any lost motion will soon batter out the babbitt or bronze lining. Pack the plungers loosely, so that there is always a small amount of leakage around them, thereby reducing friction and wear. In starting an electric pump: open the priming valve and fill the entire water-end with water; open the by-pass valve; turn on

the current and start pump and motor; open air-valves and exhaust all air from pump; gradually close the by-pass valve and note from pressure-gauge that all plungers are working; and when each plunger is doing its portion of work, close the by-pass valve and pump direct into the column. In case one of the plungers fails to deliver its proportion of water, shut the pump down and examine the valves.

The valves should be perfectly tight on the seat, and in case there is a defective bearing it should be turned up in a lathe or fitted with a hand-scraper. An extra set of valves should be available, so that if one valve shows a leak it may be immediately taken out and a perfect one inserted. A valve

high pump-speed as well as at a normal speed so that the leak if continued will soon ruin both the valve and seat. pump can be started at a normal speed and increased as the water requirements demand.

2. The working parts are made proportionally heavy so that the working head or pressure can be increased considerably over normal pressure.

3. The working barrel of the pump is so constructed that for shaft-sinking (until recently held by the Crown Mines of South Africa, where 270 ft. of shaft was sunk in 31 days), has been shattered by our Waugh clipper drill at the Miami

4. An arrangement of lubrication is so employed that all Trust Co.'s property, Miami, Arizona. We are informed that working parts can be completely oiled while the pump is in the clippers achieved 308.2 ft. through Pinal schist in 31 days, three clippers being employed in the work. Details of

The fact that the speed, size of plungers, capacity, and this remarkable Waugh record had not been received at the working pressure can be easily altered, makes this type of time of going to press, but this much is known: that the

NEW SHAFT-SINKING RECORD REPORTED

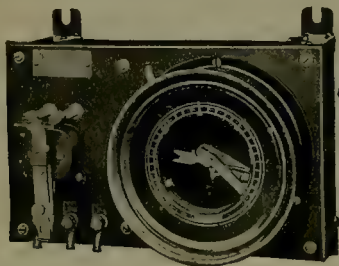
The following is from 'Keepintouch', published by the Denver Rock Drill Manufacturing Co. "The world's record for shaft-sinking (until recently held by the Crown Mines of South Africa, where 270 ft. of shaft was sunk in 31 days), has been shattered by our Waugh clipper drill at the Miami Trust Co.'s property, Miami, Arizona. We are informed that this remarkable Waugh record had not been received at the time of going to press, but this much is known: that the

world's shaft-sinking record has been broken, and that the drill that turned the trick was none other than our own little clipper. That is something to puff out the chest of every Waugh-rrior in factory and field."

NEW REGULATOR FOR MOTOR ON PRESSURE SYSTEMS

A new gauge-type pressure regulator is being manufactured by the Cutler-Hammer Mfg. Co. of Milwaukee to replace former apparatus. The new regulator consists of a pressure gauge and relay mounted on a slate panel carried on a wall-type frame, and may be used on either A.C. or D.C. circuits. It is more durable and cheaper than their former types of regulators, the manufacturer claims.

This device is used as an automatic means of controlling the pilot circuits of automatic starters used with motors operating pumps, compressors, etc., and can be used on pressure systems above or below that of the atmosphere. As the pressure falls or rises the needle indicator in the pressure-gauge makes contact with one of two adjustable contact points, thereby starting or stopping the motor when the pressure falls or rises to the points at which the contacts are set. The two contact points can be set as close as



5% of the total reading shown on the gauge, and give practical results, and can be made accessible for adjustment by unscrewing the glass cover of the dial. The pressure inlet hole in the gauge-cover is tapped for $\frac{3}{8}$ -in. pipe. The gauge can be supplied with dials reading in various capacities, the smallest being 0 to 25, and the largest 0 to 10,000, all readings being in pounds per square inch. Dials reading from 0 to 30 in. of mercury below atmospheric pressure can also be provided.

The relay used in connection with the gauge has solid copper contacts, and will operate on either direct or alternating circuits. The relay provides low-voltage release, and will operate to start the motor when the voltage returns. Pressure regulators of this type must always be mounted in a vertical position and should be connected to an independent pipe from the pressure-tank, or else to the discharge line from the pump with an air-chamber interposed between to prevent the fluctuation in pressure produced at each stroke of the pump from seriously affecting the gauge needle.

AN INDUSTRIAL SURVEY OF HIGHWAYS

Agitation by transportation experts of a movement to secure industrial surveys of highways, particularly those linking towns and communities, for the purpose of ascertaining their adaptability to motor-truck transportation for short-haul duty as a relief to congested railroad conditions has aroused a wave of interest among shippers, manufacturers, and truck-makers. The consensus of opinion of men who know the importance of the transportation system in the country's commercial activity, is that the plan will do more than any other factor to solve the shipping problems with which business is confronted. Motor-truck manufacturers, who probably are in a better position than anyone else to visualize the national transportation needs and who

know the tremendous demand for trucks to handle inter-city and inter-community hauling, are unqualifiedly in favor of the project. One of the strongest recommendations for it has been given by E. A. Williams, Jr., president of the Garford Truck Co.

"The plan is one that should be acted upon immediately," Mr. Williams said. "It will, of course, afford some permanent relief from railroad congestion, but it is needed now to take care of the situation that will prevail during the next few years. Railroads are not in normal shape. Private owners, to whom they recently have been returned after more than two years of Government control, will be hampered by red tape in restoring conditions that will even approach normal. In the meantime the motor truck must fill the gap left in transportation facilities."

COMMERCIAL PARAGRAPHS

The United Filters Corporation has moved its Chicago office from the Peoples Gas Bldg. to 1310 Tribune Bldg.

L. T. Pockman has been appointed district manager for the Chicago Pneumatic Tool Co. at Los Angeles, with headquarters at 307 East Third St. Mr. Pockman is well and favorably known among the mining men of the West and his appointment will be of interest to many.

A. O. Gates, sales engineer for the Dodge Sales & Engineering Co., has come to San Francisco to make his headquarters here. He will devote his attention principally to mining and metallurgical equipment and expects to make a trip through Arizona, New Mexico, and Colorado, soon. His office is at 1407 Hobart building.

Bulletin 'P. M. 56' issued by the Worthington Pump & Machinery Corporation aims to familiarize the 'man in the field' with the construction of the Standard McCully gyratory crusher, and give practical information to guide him in its erection, operation, and repair. It is amply illustrated and should be of service to engineers.

Smelting furnaces are among the many products of the Worthington Pump & Machinery Corporation. Bulletin 'P. M. 55' describes blast-furnaces, reverberatory furnaces, water-jackets, forehearths, and other accessories of both lead and copper smelters. Various types and sizes of equipment are supplied by the Worthington company.

B. C. Collier has been elected vice-president in addition to his present position as general manager of the Cement-Gun Co. W. J. Roberts, president of the Traylor Eng. & Mfg. Co., has also been advanced from the position of vice-president of the Cement-Gun Co. to that of president, and S. W. Traylor, formerly president of the Cement-Gun Co., is now chairman of the board of directors.

A. E. Hitchner, former manager of the mining section, Industrial Department, Westinghouse Electric & Manufacturing Co., has become assistant-to-manager, Industrial Department, in charge of mining and chemical industries. After three years as city salesman of the Philadelphia office of the Westinghouse company from 1909 to 1912, he was appointed manager of the Wilkes-Barre sub-office in the centre of the anthracite coal-field. In the spring of 1919 he was appointed manager of the mining section, Industrial Department.

Announcement is made by F. W. Davis, Jr., president of the Detroit Graphite Co., that J. W. Austin has become connected with that company with title of assistant secretary. Mr. Austin is well known throughout the paint and varnish industry, particularly by companies supplying those industries with their raw materials, through his connection for the past twenty years with the Acme White Lead & Color Works. In addition to other duties, Mr. Austin will direct the purchasing policy for the company's plants in both United States and Canada.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Deery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N.Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MAY 22, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page
EDITORIAL	
NOTES	735
OUR MOTTO	736
"Science has no enemy save the ignorant." Its broader meaning and its bearing upon the mining industry.	
OUR SIXTEENTH ANNIVERSARY	737
When we were born; the age of our contemporaries in New York and London. Former controllers of the 'M. & S. P.' Editors in the past. The debt the paper owes to Mr. Halloran. Its growth and change in sympathy with the needs of the times. An American paper, first and last.	
PREFACE	738
An introduction to the contents of this issue. The four facsimile pages typify critical periods in the history of the 'M. & S. P.' Mr. Hoover's article. The Editor and the typewriter. Mr. Hutchinson's humor. Mr. Bain writes from Burma.	
ARTICLES	
'THE SCIENTIFIC PRESS'	739
Facsimile of two pages from the first issue, May 24, 1860.	
'MINING AND SCIENTIFIC PRESS'	741
Facsimile of Earthquake-Fire Issue.	
'MINERS ADVANCE'	742
Facsimile of poster used by U. S. War Department.	
SOME NOTES ON CROSSINGS	
By Herbert C. Hoover.....	743
A peculiar form of 'crossing'. Opinions as to origin. Their bearing on ore deposition and upon mining.	
A CHAPTER IN JOURNALISM	
By T. A. Rickard.....	745
The death of Richard P. Rothwell followed by the purchase of the 'E. & M. J.' by James H. McGraw, in 1901. W. J. Johnston acquires the paper; T. A. Rickard becomes editor. The 'Pacific Coast Miner'.	
The vagaries of Mr. Johnston. Financial difficulties. H. M. Swetland becomes owner in 1904, soon to sell to John A. Hill. An offer by Jacob Lange-loth. Mr. Rickard decides to resign and acquires the 'M. & S. P.' from J. F. Halloran. He takes charge on December 1, 1905. Edgar Rickard. The earthquake-fire. Courtenay DeKalb and H. Foster Bain. The 'Mining Magazine'—a journalistic adventure. Journalism in London. Mr. Rickard returns to San Francisco in 1915. C. T. Hutchinson. "Science has no enemy save the ignorant."	
PHOTOGRAPHS OF SOME OF OUR EDITORS..... 757	
WHY IS THE MINING AND SCIENTIFIC PRESS?	
By Charles T. Hutchinson.....	758
The 'business' of the 'Business Staff'. The simplicity of publishing, from the outside; the complexity, from within. The reader, the advertiser, and the publisher; their relations. Read the ads! Elementary economics. 7000 potential buyers and the hand-picked advertisers.	
SHALL AMERICANS GO ABROAD TO MINE?	
By H. Foster Bain.....	761
Retrospection. Investments abroad. The nationalistic spirit. The attitude of various foreign countries. Circumspection advised.	
THE SPASSKY AND ATBASAR MINES IN SIBERIA—I	
By J. Mackintosh Bell	765
The Kirghiz steppes. Obstacles to mining. Further complications resulting from the War. Geology. Richness of the ore. Methods of mining and treatment. Statistics.	
THE PROSPECTOR	
By Jack Mulholland	770
The hardship of his work. The fate of the prospector who fails to find a bonanza. Development syndicates. He needs help.	
DEPARTMENTS	
REVIEW OF MINING	771
THE MINING SUMMARY	775
PERSONAL	776
THE METAL MARKET	777
EASTERN METAL MARKET	778

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.



CHANGELESS

THE hair-like lines of the thumb print are unalterable, changeless.

Because of the exacting accuracy and painstaking care made possible by the vast Linde organization, Linde Oxygen is as constant in quality as is the thumb print. To-day, to-morrow, next year—the high standard of Linde purity is invariable.

Successful Welding demands uniformity—in practice, in equipment, in gases.

That is why it is so important to use oxygen of extremely high purity *which never changes*.

The Largest Oxygen business in the world is the result of living up to these two requirements.

The
L I N D E
AIR PRODUCTS CO.

30 East 42nd Street, New York
Kohl Building San Francisco



T. A. RICKARD, . . . Editor

HOTEL and other accommodations for tourists in Europe are said to be defective and those prompted by curiosity to visit the battlefields of the recent war will have to suffer a good deal of discomfort. We hope they will. This is no time for globe-trotting of any kind, least of all to the countries still nursing open wounds. One does not visit a friend soon after a funeral. Our prosperous citizens will not make themselves liked, despite the spending of money, by poking their noses idly into the sore spots created by the most devastating of all wars. If they must travel and idle, they had better see something of their own country. We recommend them to see the many beautiful and interesting places under their own flag, in the West, in Hawaii, and in Alaska.

SAMUEL MONTAGU & CO., in a recent circular, give statistics of British gold importation and exportation, showing that in March the gold imported into the United Kingdom was valued at £4,199,155, of which £3,664,171 came from the Transvaal, and £270,139 from Rhodesia, whereas the gold exported was valued at £9,054,526, of which £4,336,005 went to India, £2,707,634 to the United States, and £1,470,441 to Argentina, Uruguay, and Paraguay. Thus the export of gold was more than twice as large as the import, and the amount sent to British India was slightly more than the whole amount imported from South Africa and other regions; indeed, the absorption of gold by India is today a large item in hindering the adjustment of the conditions brought about by the decreasing gold output of the world.

VARIOUS erroneous statements are current concerning the market for silver. There is no truth in the rumor that our Government is selling silver to India or to any other foreign government. It is equally untrue that the mint in San Francisco has been closed, except in the usual way for a few days pending the annual clean-up. The drop in price is due to the temporary satisfaction of Oriental requirements; during the War the demand from China, Japan, and India was not satisfied; since then the removal of the embargo on shipments from this country had led to sufficient purchases to glut the market for a time. Germany was expecting to buy silver; she is unable to do so, owing to the delay in the ratification of peace with the United States and her consequent inability to trade freely with this country. These conditions will be rectified in due course. A

price of one dollar per ounce is still being paid for silver by the Director of the Mint, in accordance with the terms of the Pittman Act, whereby he is obliged to purchase all silver tendered to him at one dollar per ounce until the 271 million dollars that have been melted are replaced in the Treasury, provided that silver so tendered to him is not only produced but also reduced metallurgically in the United States; in other words, he will not accept that which is not actually mined in this country. Mexican and Canadian silver can be sold at any price under a dollar to individual purchasers, but all domestic silver is still assured a price of one dollar per ounce. If the price hold at that figure, our friend the miner will not have much reason to complain. 'Dollar' silver used to be his fondest expectation not long ago.

PLANs are completed whereby American copper producers will be able to dispose of their product in foreign markets through the medium of the Copper Export Association. The consensus of opinion is that stocks in Great Britain and France are low, and that, with the completion of arrangements for foreign financing, export business will rapidly deplete the present surplus in this country. The price reported as having been agreed upon is 20 cents per pound, which is considerably below the figure originally proposed. The arrangement provides for 90-day credits, the vendors being protected by deposits of foreign government bonds or by guarantees from French and British bankers. The generally accepted view is that exportation to Japan is out of the question on account of the financial condition of that country. Estimates of unsold metal in the hands of refiners here vary considerably, but it may be taken that there is in stock half a billion pounds, although the sales into consumption since January 1 have exceeded production, and the excess at present is growing steadily with the increase of manufacturing activity. Of course, the rate of production at approximately 50% of normal capacity, which has been maintained by most of the large producers since the beginning of 1919, is not to the liking of the stockholders, and, if continued, can have but one result, namely, greatly decreased dividends. The Jackling companies, for example, each drew heavily on the surplus created during 1915, 1916, and 1917 to provide dividends for 1919, and both Chino and Ray have reduced their disbursements for the first quarter of this year by one-half. They, however, have fared better than

other mines, in Michigan and elsewhere in the West. On the whole, the outlook is encouraging.

IN an advertisement in one of our local newspapers, offering stock in a gold-mining company operating at Grass Valley, California, we note the statement that the area in which the mine is situated "grows richer the deeper you dig". This refers particularly to the Empire, North Star, and Idaho-Maryland groups of mines. It is not true. Moreover, it is remarkable how this ancient fallacy survives, at least sufficiently for the purposes of promoters. The North Star vein has 'petered out' at the bottom of the mine, 2500 feet vertically below the surface, and the future of the property in depth depends upon another vein that enters the ground from an opposite direction. Even this is not as rich as was anticipated at the time when litigation with the Empire was avoided by a reasonable compromise. The fact that one or two mines in a given district survive after their neighbors have ended their economic lives is not a proof of enrichment in depth, but is the result of consolidation, smaller overhead expenses, the enlarged scale of operations, and more effective metallurgic treatment. The general statement that gold mines in any district "grow richer in depth" is no more true than the statement that men grow stronger the longer they live.

WHILE politicians are playing with the soldier-bonus proposal at Washington, it is interesting to note the recent utterance of Lord Shaughnessy, a stalwart Canadian whose peerage is significant simply as a mark of honor bestowed upon a man of rare ability and character, born an American and risen from the ranks. The chairman of the Canadian Pacific Railway company remarked: "The American soldier's demand for a \$2000 bonus has its counterpart in the Canadian's claim for \$2500. Canada has provided for her soldiers, their widows and children. . . We hesitate to comply with a demand which would dim a record as illustrious as the classic glory of ancient Greece, and would entail a greater final money loss on them than any possible benefit. For ourselves we feel that no man who has lived long enough to remember the expanding corrupting pension systems built up out of the Civil War would care to see the experiment tried here." To this we venture to add that not as much has been done for the crippled soldiers and those out of work as might have been done, nor as much as has been done for the Canadian soldiers, and that we hope this national duty will not be neglected; but to pay a bonus to those who went through the campaign unhurt is indeed to sully a splendid performance by measuring it in dollars. It is only one more phase of class legislation, which opens the way for all sorts of political play, hurtful to the best interests of the nation.

FOREIGN trade statistics are informing. The increase of our export trade, in the face of unfavorable rates of exchange, is remarkable. During March, the latest month for which figures are available, Europe took 56% of our total exports, as against 62% last year. The de-

preciation in exchange affected our commerce with Italy and France; in nine months there was a drop in our exports to Italy from 381 to 299 millions; during the same time France imported 565 millions as against 696 millions in the corresponding period last year. Even these decreases are not as large as might have been expected. On the other hand, England took 221 million dollars worth of goods from us in March as against 132 millions a year earlier and as against 169 millions in February, when exchange was at the worst. An increase in the sale of raw materials is the chief fact, our shipments of crude stuff comprising 27½% of our total exports to England in March, whereas a year ago in the same month this item represented only 16½%. The revival of trade with Germany is the more striking; in March our exports thither amounted to \$21,000,000, as against \$18,000,000 in February, and nothing a year ago. In regard to imports, we bought \$85,000,000 worth from England, France, and Italy in March, as against \$26,000,000 a year ago. These figures indicate increasingly healthy conditions and accentuate the wonderfully strong position of the United States in the commerce of the world.

Our Motto

A good wine needs no bush and a suitable motto should require no explanation. Nevertheless, it seems fitting at this time to give reasons for the faith that is in us. "Science has no enemy save the ignorant." It is a true saying and worthy of all acceptance. Time was when the mariner cut down the oak and made him a vessel wherewith to cruise the seven seas; he depended upon the fickle wind to propel his ship and he steered by the light of the stars. As he fared forth across the main and began to make traffic over the waste of waters, he found the need of something stronger than the old wooden boat, something more certain than the stars. His brothers took the iron from the earth and gave him steel to sheathe his ship, they dug the coal from which he drew the throbbing energy that furrowed the wave, they made him a compass whose trusty finger should point a path when the storm curtailed every star. Navigation became a science and naval construction an art. So also those who go down to the mine in skips; to them Science gave tools, energy, and a light wherewith to illuminate the dark places in the earth. The simple digging of ore was well enough so long as the miner did not penetrate far from the daylight, using pick and spade to move the mineral, applying his muscle to carrying the product of his toil and the sight of the ore as the guide to his advancement. But as he burrowed farther, these simple ways did not suffice, he harnessed the horse to his windlass and made a whim, he yoked the oxen to the cart that carried his ore, he compelled the torrent to turn a wheel and drain his hole in the ground. Then, penetrating to a depth greater than the height of the tallest trees, he found simple mechanical methods began to fail, he called on Science for help, for further he could not go alone. Aid was given abundantly. Steam replaced muscle, steel

replaced wood, and engineering took the place of rule of thumb. Far from daylight he penetrated into the adamant heart of the earth, until he walked in galleries a mile beneath his dwelling.

But even that was only a beginning. Science sharpened his tools with the diamond and quickened his operations with electricity. And then with faithful hand and trusty word, she told the miner how to separate the waste rock from the valuable mineral, the dross from the metal. Metallurgy became an art. Nor was this the end. Science did more; in every department of his manifold operations she breathed a system which crystallized into a great industry, orderly as the arrangement of a crystal, smooth as the working of a machine. The prospector became a geologist, the miner became an engineer, the hole in the ground became the basis of a business that supported a vast community. And yet the story is not told, for Science became more than an aid to work, she became a companion in pleasure, a guide, a philosopher, and friend. As the piece of ore is converted to burnished silver, so the old common sense was transmuted to a trained intelligence ready to cope with every problem in life. Man went forth to conquer, first nature and then himself. Self-reverence, self-knowledge, and self-control led him to sovereign power. Therefore, as a child to its mother, as a patriot to his native land, so he who mines the ore, who wins the gold, refines the silver, or smelts the lead, turns to the fairy who has blessed his going forth and his coming home; he honors her ways, which are ways of truth; he follows her light, which suffers no eclipse; and to those that follow he says, "With this sign shalt thou conquer: 'Science has no enemy save the ignorant'."

Our Sixtieth Anniversary

In a young commonwealth, like California, sixty years is a long time, for it includes a period of remarkable development. The 'Mining and Scientific Press' was founded on May 24, 1860; we celebrate the anniversary with this issue. Among the mining periodicals published in the English language, the 'Mining Journal' in London is 86 years old, 'The Mining Magazine' has 11 years behind it, while the 'Engineering and Mining Journal' in New York is our junior by six years. When our paper was founded in 1860 under the name of the 'Scientific Press', it was devoted mainly "to the interest and advancement of the mechanic and working man"; it sought "to encourage home manufactures". When only three years old the word 'Mining' was added to the title by Alfred T. Dewey, who directed the publication for 30 years and is remembered in the name of the company, the Dewey Publishing Co., by which the business is conducted today. Mr. Alfred Holman, the distinguished editor and proprietor of 'The Argonaut', was associated in the control first with Dewey and then with Mr. J. F. Halloran, from 1891 to 1898, after which Mr. Halloran controlled the paper alone until the present writer acquired it in 1905. Mr. Charles G. Yale was editor from 1871 to 1893. Among the editors in other days were the

late Almon D. Hodges, W. H. Storms, Clarence S. King, and Mr. E. P. Piper, the last being editor now of the best daily newspaper on the Pacific Coast, the Portland 'Oregonian'. The 'Mining and Scientific Press' grew and progressed with the mining industry of the West. To Mr. Halloran it owed a great deal; although not a technician himself, he recognized the growing importance of the application of the sciences to the ancient arts of mining and metallurgy; he gave increasing space to matters of technology, and brought his sturdy independence to the development of the paper, so as to give it individuality and character. When he handed the reins to his successor the time had come to accentuate still further the growing part that science was playing in the winning of the metals. In this respect the 'Press' is like its contemporaries in other parts of the technical field; it has responded to the needs of the time and has reflected the increasing complexity not only of mining and metallurgy, but of life itself. It is the recognition of a larger duty and the awakening to a wider opportunity that has caused a progressive change in the editorial policy of this paper. The crisis of the Great War intensified the development from a purely technical publication to one that ministers to the intellectual needs of technical men. Man does not live by bread alone; the men of the mine and mill, the smelter and refinery, are interested in things other than the digging and reduction of ores. They are citizens in a commonwealth, not mere pawns of industry. The engineer, a term that in its fullest sense includes all those who use technical science in their daily work, has awakened to his larger duties and his ampler scope as a member of the community; he has realized his responsibilities as a citizen and recognized the expansion of his interests as a thinking individual. The 'Press' has become a 'class paper', that is, one published in behalf of a special class, namely, the industrial and engineering group whose particular effort is devoted to the legitimate exploitation of mineral resources, primarily in the United States, but secondarily wherever American initiative has found its way. Anyone comparing our paper as it is today with the one published twenty or thirty years ago will find that the principal change has been in the greater space given to the editorial and discussion departments. The 'Press' has become an organ of opinion as well as a recorder of technical progress. In this respect also it marches with the times, for the spread of education and the increased participation of educated men in mining affairs have called for the expression of opinions by the editor in one department and by the reader in another, both working together in the hope of sifting fact from fancy, truth from fiction, the essential from the non-essential.

Our motto is 'Science has no enemy save the ignorant'; and the science we have in mind is the one defined by Huxley as organized common sense, not the science of the library and the laboratory only, but of the stope and bench, of the intelligent performance of human effort both in the darkness underground and upon the sunlit surface of the earth. Science has given a willing hand

to the delver in the mine and to the craftsman in the mill, and they have been eager to accept her help. They have asked for the results of research and the records of experience. The 'Mining and Scientific Press' has tried to give them what might serve them best, and to do that it has gone not to the dusty shelves of dead books but to the wells of living knowledge, to the men who have done things, to those in the very van of technical advancement. To the leaders of the profession, to the consultants in mining and metallurgy, to the superintendents and managers of mines, mills, and smelters, this paper is indebted for the steady flow of practical information that it has been enabled to publish. To its readers also it is indebted greatly. As our business manager, Mr. C. T. Hutchinson, says elsewhere in this issue, they are the foundation upon which a publishing enterprise is built. To the editor they are more than that; they are his friends and supporters, they are the source of his strength. Only a few are known to him personally, yet he is conscious of a friendly cloud of witnesses and responds to the larger stimulus of a widely dispersed clientele.

Our paper reaches the remotest parts of the world, wherever the English-speaking people have penetrated in their search for the hidden ore; yet the 'Mining and Scientific Press' is essentially an American paper. At its start it was Californian; later it became Western; today it is American. That affords a scope, in spirit and in substance, large enough for any journalistic effort. It is not circumscribed by the boundaries of the United States, for American enterprise goes ahead of the flag and opens avenues of commerce to the remotest corners of the earth, as Mr. H. Foster Bain, one of our former editors, explains in an article contributed to this anniversary issue. Our country is awakening to a larger responsibility and a wider outlook in its political and economic relations with the rest of the world. It is probable that the next decade will see the American mining engineer taking a part even more varied and exacting than his past participation in Canadian, Australian, and South African mining affairs. In a real sense, the whole world will be his field. To meet the call of his new opportunities he will need more than ever the aid of the newest technical knowledge and the most recent economic experience. It is the mission of the 'Mining and Scientific Press' to adapt itself to the requirements of its readers and adjust itself to the demands of its clientele; and this it cannot do effectively without cordial co-operation between the editor and the engineers, for, after all, the Greek word for editor still holds good, he is the *sunfactes*, he who assembles the information. He assembles it and co-ordinates it so that it may perform its service efficiently. On such assistance we count confidently. For the cordial and ungrudging support given to us in the past, we tender thanks most sincerely. In behalf of a long line of editors, some of them now across the range, we thank the thousands of readers by whom this paper has been supported so loyally. Gentlemen, on this auspicious day, we proffer greetings of good-will.

Preface

The four pages that follow typify three great events in the history of our paper. We reproduce two pages of the first issue, which appeared on May 24, 1860. Next we give a facsimile of the 'disaster' issue of April 21, 1906, printed while San Francisco was burning. Last there is added a facsimile of the poster embodying an editorial appearing in our issue of November 10, 1917, that is, during the period of the Great War. A thousand copies of this poster were printed at the request of the War Department of the United States for the purpose of stimulating recruiting in the mining communities. The first article is one that Mr. Hoover wrote for the 'Mining and Scientific Press' of February 21, 1896, a few months after he graduated from Stanford University and while he was at Grass Valley. This was the first that Mr. Hoover wrote for any technical paper. It is interesting in itself, as a note on the relationship between the distribution of ore and the geologic structure of veins in an important gold-mining district; it is doubly interesting as coming from the most striking personality developed during the crisis of the Great War. Our own reminiscences call for no comment, except that the artist has misrepresented the Editor as using a type-writing machine; we would be sorry if this cartoon should lead any young man into the belief that composition is facilitated by the use of a machine; on the contrary, we do all our writing, except ordinary correspondence, in long hand, using a soft pencil. The article by Mr. Hutchinson, our business manager, will please our advertisers, as well as our readers, because it betokens a streak of humor without which life would lose its savor. Mr. Bain sent his contribution from Rangoon, Burma. It is most timely, for at the moment when it went to press the Foreign Trade Convention was in session in San Francisco. In the future, as in the past, one of the most valuable items in our export trade will be the American mining engineer, therefore Mr. Bain's discussion of the opportunities and duties awaiting the members of our profession abroad is highly pertinent. The subject is illustrated further by Mr. Mackintosh Bell's article, describing copper-mining enterprises in Siberia, to the development of which American technical advice has contributed usefully, in cordial co-operation with British technicians. Last, we give a page to the address delivered by a prospector, Jack Mulholland, before the recent mining convention at Seattle. It will serve to remind us all that to the prospector we owe the very beginnings of mining exploitation. Mr. Mulholland is the organizer of a prospecting association that is doing good work in British Columbia, therefore his suggestion that the literature of mineralogy and geology intended for use in the field should not be burdened with too many "jaw-breaking" terms. This will provoke sympathy, as well as a smile, for the prospector is not the only man discouraged from reading scientific books by their clumsy terminology and verbal obscurities. The editorial on our motto is reproduced from the issue of July 7, 1906.

The Scientific Press.

A Journal of Science, Art, Manufactures, Chemistry, Inventions, etc.

VOL. I.

SAN FRANCISCO: THURSDAY, MAY 24, 1860.

No. 1.

THE SCIENTIFIC PRESS

IS PUBLISHED WEEKLY,

BY GEO. H. WINSLOW & CO.

Office, 173 Washington Street, over Atwill's.

TERMS OF SUBSCRIPTION—For 1 year, mailed to any part of the State.....\$4 00
For 6 months, " " " " 2 50
For 3 months, " " " " 1 75
Single Copiespayable to Carriers.....12½ cents
TERMS OF ADVERTISING—10 lines, or one square.....for one insertion.....\$2 00
20 " two squares..... "\$3 00
Considerable reduction made to permanent advertisers.

PROSPECTUS.

THE People of California will be pleased to learn that the publication of the above named Weekly Periodical has at length been undertaken, and that the first number will be speedily issued. There is much latent genius in this State, whose discoveries and inventions would prove valuable, both to Professional men and Mechanics; but for the want of a proper exponent, such discoveries and inventions must remain hidden.—The Publishers have undertaken to become this exponent, and will issue a Weekly Periodical in octavo form, to be called the SCIENTIFIC PRESS, to appear every Saturday noon.

The columns will be solely devoted—

I. To the interest and advancement of the Mechanic and Working Man; to instruct them in all that is useful and advantageous to their Trade or Profession, and inform them of all the latest and most approved discoveries in Science and Art.

II. To advance, encourage and protect "HOME MANUFACTURES." The ruinous system heretofore existing in this State, of sending away on an average \$2,000,000 per steamer needs reforming. This State possesses sufficient raw material, with eager hands to labor to transform the same into fabrics. San Francisco, the great Emporium of the Pacific, can and will furnish the coast north and south, as well as the interior, with all the necessary implements.

III. Inventors of useful Machinery and Instruments, will find this the only medium in this State wherein their claims for Patents may be successfully prosecuted. It is therefore requested, that those interested should at once leave with us their plans, drawings and models, with explicit specifications, and such other information as they may possess relating thereto. The Publishers have made arrangements with an able and successful law firm at Washington, as well as in this city, who will, at moderate fees, prosecute the claims of patentees, both in the United States and Europe. The Publishers will attend to all transactions pertaining to the sales of Patent-Rights either here or on the other side of the Pacific and Atlantic. We shall also keep a record of all New Patents entered, as well as those whose term has expired.

IV. The Publishers will give a history of the rise of our Manufacturing Establishments, a complete synopsis of the number of hands employed, articles manufactured, as well as the *modus operandi*, and such other particulars, with illustrations.

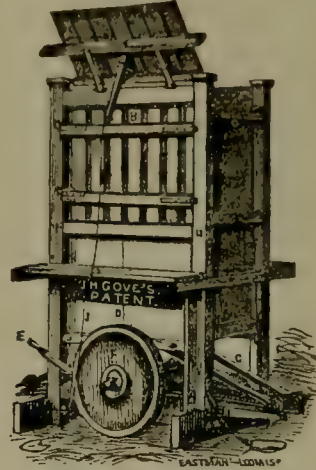
The "Scientific Press" will be edited by several able and acknowledged writers, whose Philosophical and Scientific acquirements stand pre-eminent here and abroad, who will also reserve to themselves the right of criticizing the Drama, Literary and Musical productions.

The Publishers will issue five thousand copies as a beginning, which will be sent to all parts of the State and Oregon, the Atlantic States and Europe.

GEO. H. WINSLOW & CO.,
Proprietors.

READ THIS!—The *Scientific Press* will give every week a treatise upon all the arts, science, trades, and manufactures, which will not only be entertaining but vastly useful. These articles will be written by the most talented men in this State, who have kindly volunteered, and whose literary acquirements stand pre-eminent, combined with a practical and theoretical knowledge of the subjects they may treat of, which will not fail to create the most intense desire for every issue.

J. H. GOVE'S PATENT HAY PRESS,



Our readers will be gratified to learn, through our first issue, the existence of a Patent Hay Press, invented by Mr. J. H. Gove, of California, for which he obtained a patent from the United States Government in March, 1860, through his agents, Messrs. Wethered & Tiffany, of this city. Patent-rights are now being sold to Counties for \$1,000—Solano County being the first to purchase a right. The patent is issued for the usual period, 14 years, No. 27,361, the particulars of which will be found on another page of the *Press*. Arrangements in the Atlantic States for the sale thereof have been effected. The superiority of this machine over others, is amply testified by numerous notices from the press, as well as by certificates from those who have purchased and used it. This machine may be properly termed a combination of the Railway and Lever Press (See cut and diagram.) We congratulate California, and the inventor, Mr. Gove, upon this important labor-saving utensil; may he reap the reward he so justly merits.

It is estimated that this machine can press from twelve to fifteen tons of hay per day, with three laborers and a pair of horses. Mr. Gove has personally worked at the rate of two tons of hay per hour, in this city, making them in bales weighing from 275 to 350 lbs. to the bale, thereby pressing 100 lbs. more hay—contained in less space than a common 200 lb. bale, which naturally enhances the value of the hay—is more desirable for shipment, and creates less wastage. For further particulars, we refer our readers to the patentee, Mr. Gove, or his agents in this city.

(A). The top lid, as shown open, has a cross-bar which serves to be fastened by loops thrown over each end; which connected by means of rods running to the bottom of the press contracting the pressure from the levers (K) in diagram.

(B). The front door, slatted corresponding with the back of the press, the apertures being for passing ropes or wires for the tying of the bale.

(C). An end door, which retains its position by catches on the inside of door (B), and when (B) door is thrown open, end door (C) recedes enough to allow the bale to be extracted easily.

(D). The follower of the press to which are attached the upper end of the levers (K) in diagram, also slatted to correspond with the door (B) and lid (A), allowing the ropes or wires to pass under the bale.

(E). Is a ratcheted pull-lever which serves to throw off the pull from the ratcheted wheel for the purpose of lowering the follower to its original place.

(F). A grooved wheel containing a rope or chain propelled either by manual or horse power, is attached to a center shaft upon which the chains (M) wind in diagram.

(G). In diagram, are iron rails upon which the grooved or flanged wheels (I) move, and form parts of levers.

(H). Are the levers or arms forked on the lower end, within which are placed wheels (L), connected together by a cross-bar.

(M). Are chains connected with the cross-bars at the forked ends of the levers (K), thence to center shaft (P), to which shaft the power wheel (F) is attached—thereby winding the chains around the shaft, bring the lower ends of levers (K) together, which forces the follower with great power upwards, until the arms or levers are raised nearly perpendicular.

(I). A rope running in grooved power wheel (F) for the purpose of working the press.

(J). Another rope attached to a lever on top lid (A) for the purpose of opening and shutting the same in filling and pressing.

(K). The levers or arms (K) are so constructed with forked ends, that one pair of them pass each other at right angles at the top, which principle insures greater force and power than heretofore attained.

To the Mechanics and Manufacturers of this State.

Actuated by the noblest motives, and the period being quite propitious—we have resolved to enter upon the labor of publishing an advocate and exponent in your behalf. We say labor, because much requires to be done before the chief ends of your business avocations, rights and privileges are achieved. The abuses heretofore existing in this State, with reference to the workingman and laborer, need strenuous efforts for improvement. Heretofore, but a meager attempt in manufacturing has been carried on, and if any, only such articles which were for immediate use. In consequence of this and the fluctuating times prevalent in this State, the leading manufacturing establishments never have kept any number of hands for an extended period in their employ. The causes are obvious, as every mechanic who has been here but a short time knows. The State being yet in its infancy has therefore demanded but little; the price for labor has necessarily been too high—and, as a general thing, the market has been overstocked. These are some of the chief causes of the mechanics' want of success. To these may be added the want of the requisite material and machinery.

But California has, for its extremely short existence as a State—a matter of ten years or more—created and executed more than perhaps any other State in the Union, or elsewhere. Backed by an indomitable and go-aheadative spirit, possessing more enterprising, and the shrewdest business men that can be found on this globe, she possesses a *literati* for every science and profession. She has also established permanent institutions for the prosecution of the resources of the State, numerous libraries, free schools, and private academies of learning. We have wandered somewhat from our subject, for the reason that what we are about to assert may be more firmly established; it is this: "*We predict that California in less than ten years will be a manufacturing State, notwithstanding the fabulous gold and silver fields with which she is forever haunted and constantly kept in a hot fever.*" The mechanic and laborer have been induced heretofore to search for the precious metal. Some have found it; the most of them had better remained at their workshop. Their hard-earned dollar would have realized tenfold its value in a more permanent investment, such as tools and machinery, real or personal estate, than in purchasing fictitious mining claims, thereby becoming the innocent dupes of unprincipled speculators.

We wish at the same time to be understood, that we do not refer to the actual miners—because they, perhaps, are devoid of a profession or trade—or to capitalists or owners of established mining fields—they can and do find sufficient laborers to work their respective claims.

We cannot deny that it is due to her immense auriferous wealth that California has achieved her great renown in the

world; but we consider that the time has now come when her other immense resources should be worked into fabrics and utensils. Capitalists could not find a safer or more permanent and paying investment. The facilities for exportation are not only extensive and accessible but particularly lucrative and profitable.

The shipments of nearly two millions of dollars bi-monthly, would thereby be materially reduced; instead of the money going out of the State, it would help to establish an exporting community, and would give thousands of eager hands who seek our golden shores, employment. Trade would assume a healthier aspect, and be established more permanently. Losses by shipments would be avoided, and the system of monopoly in articles heretofore sent to us and none manufactured would not be heard of; to say nothing of the time lost in waiting for the arrival of merchandise, freight, and the interest of the capital invested in the meanwhile.

J. E. Emerson's Eyeless Pick.

The annexed highly useful Implement, or Pick, was patented by the gentleman who heads this paragraph, in March, 1859. Mr. Emerson manufactured in the city of Sacramento, these Picks, until the 1st of July, 1859, when Messrs. Emerson & Jones disposed of their patent-right for the United States, to Messrs. Nelson & Doble, of this city, by whom the "Pacific Tool Com-

pany" has been established. (See

EMERSON'S PATENT, MARCH 29th 1859.

advertisement in another column.) We learn that up to May, 1860, over 300 dozen of picks have been disposed of by them. This firm employs quite a number of hands, who have gained considerable experience in the manufacture of these tools. They have received orders from Oregon, Utah, and the Washoe mines, which serve as a proof of the satisfaction which these picks give. Messrs. Nelson & Doble have received from the Committee of the last State Fair, a very high recommendation accompanied with a silver medal. For further particulars we refer our readers to Messrs. Emerson, Nelson & Doble, 89 Pine street, in this city.

ENGRAVING ON GLASS.—We translate from *L'Invention* the following account (by Mr. Gugnion) of a new process of engraving on glass, for printing the patterns for embroidery, netting, crotchet, etc., by which it is said that the labor of a month in this kind of engraving can be performed in one day. The process consists in etching by means of hydrofluoric acid which, as our readers are aware, has the remarkable property of corroding glass:

1. *Substances Employed.*—It is known that certain fatty and resinous substances are not soluble in hydrofluoric acid. Among these substances the author chooses the bitumen of Judea, to which he adds one-sixth part of gum mastic (mastic in tears); he then reduces the whole to an impalpable powder.

2. *The Design.*—The design is cut in stencil, either in paper, parchment or metallic plate, in a way to cover those portions of the glass which are to be attacked by the acid, and to leave exposed those parts which are not to be attacked.

3. *The Application of the Process.*—The glass is placed horizontally, and varnished with a very thin coating of any fatty substance (the author prefers the essence of turpentine); and the stencil plate is laid on the varnish while it is fresh. The asphaltum powder is then sifted through a very fine sieve over the surface of the stencil plate and the glass, and the plate is carefully removed, thus leaving the powder upon the glass in figures corresponding to the open parts of the plate. The glass is next exposed to gentle heat, which causes the essence of turpentine to combine with the asphaltum and the gum mastic, and the mixture, in melting, fixes itself to the glass.

4. *Treatment by Acid.*—The pattern is surrounded by a ridge of soft wax prepared for the purpose, and hydrofluoric acid, diluted with one-third its volume of water, is poured over it. In about forty minutes the etching is completed.

M**MINING AND SCIENTIFIC****P****RESS**Whole No. 2387.— VOLUME XCII.
Number 18.

"Science has no enemy save the ignorant."

THREE DOLLARS PER ANNUM.
Single Copies, Ten Cents.**MINING AND SCIENTIFIC PRESS**

ESTABLISHED MAY 24, 1860

Published Every Saturday at Berkeley, California.

EDITED AND CONTROLLED BY T. A. RICKARD

SPECIAL CONTRIBUTORS

Philip Argall	J. H. Curle.
Leonard S. Austin	H. C. Hoover.
Francis L. Bosque	Walter P. Jenney.
R. Gilman Brown	James F. Kemp.
J. Parke Channing	C. W. Purlington.

BERKELEY, APRIL 21, 1906.

ANNUAL SUBSCRIPTION.

United States, Mexico and Canada \$3
 All Other Countries in Postal Union One Guinea \$5

EDGAR RICKARDBusiness Manager

BRANCH OFFICES:

NEW YORK, 921 24 Park Row Bldg.
 CHICAGO, 1164 Monadnock Bldg.

BOSTON, 27 State St.
 DENVER, 425 Alpler Bldg.

PUBLISHED BY THE DEWEY PUBLISHING COMPANY

Entered at the Berkeley Postoffice as second-class mail matter.

TO OUR READERS

IN face of the calamity that has befallen the community in which we live, our own loss seems small. Our records, our library, the note-books of the editors, the manuscript ready for the printer, and the whole of the plant in our composing room, all lie buried under the ruins of San Francisco. But, owing to the customary precaution observed by two of us, complete copies of the weekly subscription lists had been

taken to Berkeley, so that we possess that necessary record. Fortunately, most of the members of our staff live at Berkeley, where the earthquake was less severe and where no conflagration followed in the wake of this terrifying occurrence. As the earthquake occurred at 5:15 A. M., and the fire in San Francisco prevented people on this side of the Bay from reaching their offices, most of us were spared the horror of scenes that sear the memory. We are fortunate, therefore, as compared to many of our fellow citizens. And for other reasons. Our plant has been demolished; but this journal is built on nothing so ephemeral as paper, and on nothing so cheap as machinery; it is based upon the support of many thousand readers and subscribers who are never less likely to withdraw their support than at a time of misfortune.

The goodwill of the Mining and Scientific Press is locked up in no safe, confined to no printing room; it cannot be shaken by an earthquake or consumed by fire. And, gentlemen, our friends, there is another something that is not destructible by physical misfortune or financial adversity, and that is the spirit that gives life to the printed word.

T. A. RICKARD,

Berkeley, April 20, 1906. Editor.

TO OUR ADVERTISERS

OUR old offices at 330 Market Street, being in the very center of the most damaged section of San Francisco, have been totally demolished. We have lost our entire mechanical plant, including cuts, half-tones, type and the issue of April 21, which had already been set up; but fortunately, our complete and most recent mailing list has been saved.

We have secured ample offices in the First National Bank Building at Berkeley, which is on the east side of the Bay of San Francisco and close to the terminus of the trans-continental railroads. Through the courtesy of The Standard Publishing Company, we are in possession of proper facilities for printing. The Miehle presses, which will do our work, are new and of the most improved type. We will only be handicapped (for a few issues) by scarcity of paper; the rush of work at the local photo-engraving houses will prevent the use of half-tones with our reading matter, but we have arrangements pending to have this work done at Sacramento, which city was not affected by the earthquake.

We would urge all of our advertisers whose places of business have suffered, to communicate with us at the earliest moment, as our issue of April 28th will afford the best medium for advising their clients the world over of any change of address.

EDGAR RICKARD,

Business Manager.

MINERS ADVANCE!



A TELEGRAM from Major O. B. Perry informs us that the Engineer Corps of the United States Army has been authorized to raise, by voluntary enlistment, a special mining regiment to consist of six companies of 250 men each and to be known as the 27th Engineers National Army. This regiment is now being recruited, the first having been formed and placed in training at Camp Meade, Maryland. The regiment is to be composed entirely of picked men representing various mining districts throughout the country and comprising all the trades and occupations incident to mining. Each company will contain representatives of every branch of mining work so that it can operate as a unit. The men most wanted are experienced miners, both hand and machine drillers, shovelers, trammers, timber-men, track-layers, pump-men, blacksmiths, tool-sharpeners, electricians, machinists, carpenters, surveyors, time-keepers, cooks, shift-bosses, mine-foremen, and top-men. The work to be done is purely military in character, and is what is known as 'first line' work; it consists in the preparation of underground shelters for the fighting troops and the placing of explosive mines. Such work requires a high degree of skill in rapid tunneling and involves the handling of all sorts of material, from clay and chalk to the hardest rock. In addition to the regular engineering equipment, each company will be provided with special tools, such as tunneling and boring machines, drills, compressors, hoists, and lighting sets. Although the chief function of the 27th regiment will be underground mining, the men will be trained to fight as well as to dig; an engineer officer of the Regular Army will be placed in command, the other officers being selected mainly from the mining engineers that have already volunteered and undergone training. Major Perry and Captain W. H. Landers, two mining engineers well known in the West, have charge of the enlistment. Applications should be addressed to the Commanding Officer, 27th Regiment, Office of the Chief Engineers, Washington.

This announcement should meet with a ready reponse from the younger members of the profession and from the men that are working with them in the mines. It is a gratifying compliment to the mining fraternity and offers an exceptional opportunity to perform patriotic service under favorable conditions. This will not be the first time that a regiment of miners has played a noteworthy part in history. During the Indian mutiny, in 1857, when the residency at Lucknow was defended by the troops under Sir Henry Lawrence, the regiment that held the fort was the 32nd Duke of Cornwall light infantry, known as the Cornish regiment, because it was recruited in the old mining county of Cornwall. They made a victorious stand, largely because they were able to countermine the sapping of the Sepoys. As the chronicler says, "they took kindly to mining." We shall be surprised if some of the American descendants of those Cornishmen do not find their way into the 27th Engineers of the National Army. Brothers of the pick, this is your chance. Assert your manhood. You have been the pioneers of industry in the waste places of the earth. Now it is your privilege to save civilization from the onslaughts of organized hell! Enroll yourselves not only to keep the world safe for democracy but to keep your hearths and homes safe from piracy on land and sea. Miners, follow on!

From the MINING AND SCIENTIFIC PRESS, San Francisco, November 10, 1917

Some Notes on Crossings

By HERBERT C. HOOVER

From the 'Mining and Scientific Press' of February 29, 1896

There occur in a number of mines in the Grass Valley and Nevada City districts certain local variations in the country rock known to the miners as "crossings". The term "crossing" is very unsatisfactory, because it is used to indicate almost any interruption in the course of the vein, whether it be a fault, dyke, or cross vein. But there is a peculiar form of crossing which affords many points of interest, whose origin seems to lie in none of the above causes. They are lenticular masses or streaks in the country rock, crossing the vein at irregular angles, are usually softer than the inclosing rock, schistose in structure, vary from a few inches to several feet in thickness, and extend along the dip of the vein from a few feet to the entire depth of the workings. They present many features of importance to the miner, for not only do they afford an easy channel for cross-cuts, but they may control the extent of the pay-chute, or even the entire vein filling.

The most typical of this variety of crossing are those of the North Star mine at Grass Valley, called to my attention by Mr. Louis Janin.

In the North Star mine there are a number of these crossings, there being as many as four in one level. Some of them extend only a short distance below and above a level, while others extend through several levels, and one, the west crossing, extends throughout the workings, about 2800 feet, and forms the western limit of the ore body.

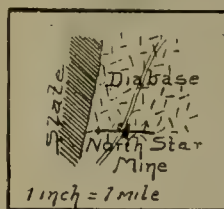
On approaching the crossing the quartz usually shows one of two phenomena, either splitting into a network of stringers or ending abruptly, but in either case continuous on the opposite side. The crossings thus form either a breccia of country rock or a "horse" in the vein. The network of stringers sometimes extend into the crossing itself for a few feet on either side of the vein, and giving rise to the suspicion that a cross-vein has been encountered.

There are many current opinions as to the origin of these crossings, some contending them to be streaks of decomposition, or that they are the result of shearing by faulting. But neither is tenable in the North Star case, because either theory would necessitate that the crossing extend from the surface to considerable depth; and, moreover, the vein shows no indication of displacement. Therefore, it is necessary to seek some other explanation, bearing in mind that the crossings are older than the fissure, for they are brecciated by the quartz; that they are mere lenses in the country rock, and not due to either shearing or decomposition.

The North Star vein is a true fissure vein, having an east-west strike, a dip to the north of about 20°; and for

the most part in diabase porphyrite.* The vein has been worked for 2800 feet along its dip.

From the cut herewith presented§ it will be seen that the rocks in the vicinity of the North Star mine are of two formations, slate and diabase porphyrite. The contact between them runs almost north and south, and passes near the west end line of the North Star ground. The diabase porphyrite is of igneous origin, and has been intruded up through the slates,† shattering them,

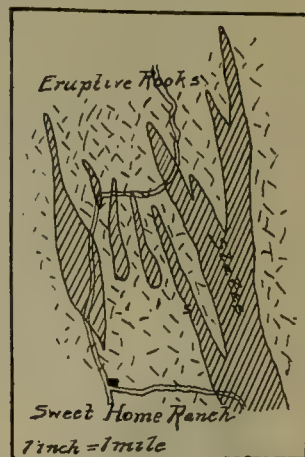


From Smartsville Folio
U. S. G. S.

forcing long dykes and tongues into their fissures and sometimes completely enveloping large or small masses. Splendid examples of such formation on a large scale occur at Sweet Home Ranch, ten miles south of Grass Valley. And Mr. Lindgren has noted the occurrence of such inclosures of slate in the Ophir district near Auburn.‡

I have microscopically examined slides from some of the North Star crossings and find them to be schist, metamorphosed from slates, which, in connection with their close proximity to the area on the west, and their general parallelism with its strike, make it quite positive that they are merely included masses of these slates.

The character of the fissure varies in passing from the hard, massive diabase to the softer, more blocky slates, much the same as fissures in different country



AFTER SMARTSVILLE FOLIO,
UNITED STATES GEOLOGICAL
SURVEY

*W. Lindgren, Smartsville Folio. Text U. S. Geological Survey.

§The cuts accompanying the article, as published 24 years ago, are reproduced herewith in facsimile.—Editor.

†Turner, 14th Am. Rep., U. S. Geological Survey, p. 472; Lindgren, 14th Am. Rep., U. S. Geological Survey, p. 253.

‡14th Am. Rep., U. S. Geological Survey, p. 253.

rocks. Mr. Lindgren,§ in discussing the character of Sierra fissures, says: "Different rocks influence the character of the fissure to some extent; in massive rocks they are apt to be straight, clear cut and well defined; in slates and serpentines there is often a tendency to splinter into a network of cracks and fissures extremely small, but often rich." When the North Star fissure passed through the hard, massive diabase it was clean

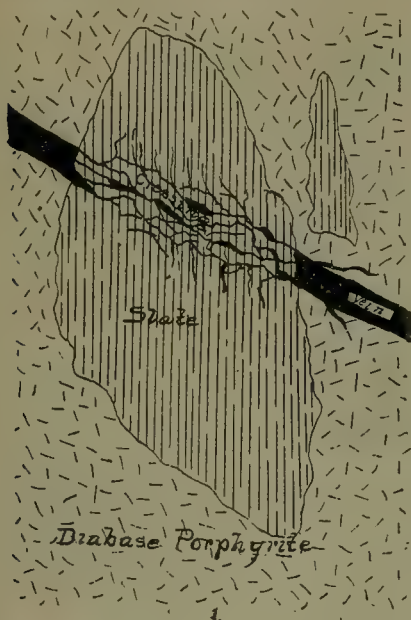


FIG. 1.



FIG. 2.



FIG. 3.

Fig. 1.—Section along dip of vein perpendicular to its strike.

Fig. 2.—Section along plane of vein.

Fig. 3.—Section along strike of vein perpendicular to its dip.

IDEAL SECTIONS TO SHOW OCCURRENCE OF SLATE CROSSINGS

cut and afforded an open channel for circulation of vein-filling solutions, but where it cut the more blocky slate inclusions the fissure became a network of small veins, thus impeding circulation or checking it altogether, as at the west crossing. Much the same phenomena might be produced by dykes into a slate country rock, the fissure forming after the dykes.

Movement along the fissure probably faulted the lenses so that the hanging wall portion does not hang directly

opposite its foot wall end. In such extensive masses as the west crossing the small exposure along the vein does not show any development, and information is hardly available in the smaller ones. At any rate, the movement has not been extensive, and its greatest effect, probably, was to scatter the crossing debris, some to each side of the crossing itself, thus accounting for the fact that the vein often splits or "raises" around a "horse" before reaching the crossing proper. (See Fig. 3.)

Where the crossings have a limited length along the dip of the vein their effect was much that of a "horse", and the solutions had no difficulty in passing around the ends of this streak of debris in the fissure, but when they are of such general extent as the west crossing they become of utmost importance.

The importance of such a crossing to vein formation lies in its bearing on the distribution and extent of ore bodies in the vein, or even of vein matter in the fissure. That this is of no little consequence is seen from the fact that the plaintiff in the case of Carson City Mining Co. vs. The North Star Mining Co. contended that inasmuch as the west crossing represented the extent of quartz in the vein, it marked the west limit of the vein, and seeks to have the end lines of the North Star readjusted on that basis.

The importance of this particular variety of crossing to the miner lies in the fact that they are often mistaken for faults when they are of considerable thickness and show no well defined walls, and useless crosscuts are run, under the impression that the vein is "thrown". In reality in such cases, not uncommon, the vein is to be found by drifting on the strike of the vein until the crossing is passed, as if it were a dyke. To distinguish between a slate lens and a real fault requires a close study of the country rocks around the mine, and their relations to each other.

In conclusion, then, I think it is evident that some of the crossings are slate inclusions in the prevalent country rocks, and perhaps dykes into slates might produce much the same phenomena; and that it is important that the crossings of every mine be thoroughly understood to more fully determine the extent of any ore body; and that they may be distinguished from faults and the expense of cross-cutting avoided.

POTASH deposits were discovered a few years ago in the Province of Barcelona, Spain, near the villages of Suria and Cardona. They consist of irregular beds of carnallite and sylvanite interbedded with rock-salt. Explorations to a depth of several hundred feet show that in the Suria district potash beds occupy an area of not less than 75 acres and occur at depths from 125 to 200 ft. The average combined thickness of the carnallite beds is estimated to be about 56 ft., and of the sylvanite about 13 ft. The Cardona upper beds are interbedded with gypsum and clay, but the lower beds contain nearly pure white salt, which is that principally mined. After the discovery of potash at Suria, these Cardona beds were searched for potash, and nearly pure sylvanite was found.

§Bul. Geological Society of America, Vol. 6, p. 229.



In 1901, shortly before his death, Richard P. Rothwell, the editor and publisher of the 'Engineering and Mining Journal', asked me to join him as associate editor. At that time I was practising as a consulting mining engineer at Denver, Colorado. I had been a frequent contributor to the columns of the 'Journal' for many years and was a personal friend of the editor, as also of Rossiter W. Raymond, then secretary of the American Institute of Mining Engineers. Dr. Raymond had preceded Rothwell as editor of the 'Journal' and later they had worked together. Soon after this offer of the associate editorship had been made, I had to go to New York, so I availed myself of the opportunity to ask Dr. Raymond for advice. He advised me against an acceptance of the proposal, partly because he thought I would find it difficult to work with Rothwell and partly because the salary mentioned was small compared with my earnings as a mining engineer. My work as a consultant was pleasant and profitable, but it necessitated too many and too long absences from home. I averaged 35,000 miles per annum for 12 years, including two voyages round the world. During the first year after my marriage, in 1898, I was home for more than a week only once. That was one reason why journalism attracted me, apart from the fact that I had learned to like writing and up to that time had contributed enough to the Institute to make a volume of Transactions, having been encouraged to do so by Dr. Raymond, who helped me greatly by his criticisms and suggestions.

Within a few months Rothwell died, after having been editor for 28 years. The 'Journal' passed temporarily into the hands of his executors, John E. Rothwell, Frederick Hobart, and F. J. Pratt. They were intimidated by their unexpected responsibilities and within a few months sold the property to James H. McGraw, who, at that time, controlled the 'Electrical World', the 'American Electrician', and the 'Electric Railway Journal'. Mr. McGraw asked Dr. Raymond to recommend an editor, and he named Dr. David T. Day, then head of the Mineral Resources division of the U. S. Geological Survey. Two years later I asked Dr. Raymond why he had not mentioned my name to McGraw, and he told me that

the reason was his understanding that I did not care to come to New York or accept such an appointment. Rothwell died on April 17, 1901. The transfer to McGraw was made in September. Dr. Day became 'editor in chief' with the issue of September 21, 1901. He appointed Edward W. Parker as managing editor, and it is only fair to Mr. Parker to say that he was the real editor during Dr. Day's incumbency, for the only editorial written by his chief was a paragraph, a 'stick' long, on his favorite topic, 'black sands'. On October 23, 1902, Mr. Parker resigned, having been appointed, by President Roosevelt, a member of the Anthracite Coal Commission;¹ a week later Dr. Day's name ceased to appear at the head of the editorial page; by that time it was known that Mr. McGraw had transferred his control to William J. Johnston, from whom previously he had bought the 'Electrical World', and that changes in the editorship were impending.

The 'Journal' was bought by Mr. McGraw for \$183,000 in September 1901. He sold it to Johnston in the following December, for \$285,000, of which \$200,000 was in notes. Johnston was an inveterate optimist and had a vague idea of meeting the payments out of profits. In 1900 he had bought a paper called the 'Mining and Metallurgical Journal', published at Los Angeles. Soon afterward he had transferred this semi-monthly publication to New York. In the summer of 1901 he telegraphed asking me to become editor; I replied that the only paper of which I cared to be editor was the 'Journal', suggesting that he should acquire it. As a matter of fact, he had tried to buy it from Rothwell, but partly because his terms were unsatisfactory and partly because Rothwell did not like to see the paper pass into his hands, he had failed in his negotiations. Early in January 1902 he telegraphed to me saying that he had purchased the 'Journal', and I replied with congratulations—but nothing more. His name as president appeared on the first page of the issue of January 4, 1902, with the statement, "with which is consolidated 'Mining and Metallurgy'". The announcement was made that McGraw would con-

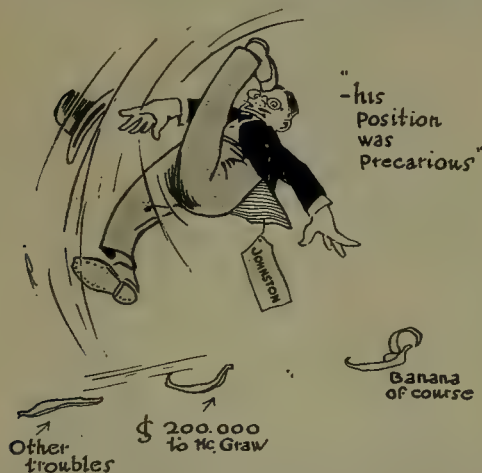
¹Mr. Parker is now director of the Anthracite Bureau of Information, at Philadelphia.

tinue as a director of the company. Within a month Johnston wrote asking me to be editor of the 'Journal', and I sent a friendly reply, whereupon he came to Denver, where we made an agreement in February.

When Johnston was negotiating with me, at Denver, he suggested that I should practise as an engineer during three months of the year and thereby add considerably to my salary as editor. To this I replied unhesitatingly that his suggestion was not in the best interests of the 'Journal', that such an arrangement was highly inadvisable, and that I would not be a party to it. He agreed to pay me \$7500 per annum, and it was arranged that I should begin my duties as editor on the first day of 1903. I offered to put some money into the enterprise; he jumped at this, so I gave my check for \$10,000 forthwith and promised \$15,000 more as soon as he would outline his plan of organization. From Denver he went to San Francisco, and, before returning to New York, he asked me to assist him further. I began to suspect that he had not completed the purchase of the 'Journal', although he

par on an 8% cumulative basis. As I had agreed to take 500 of them, there remained 1500. On my return to Denver I wrote to my friends in the profession, offering the preferred stock, which was readily absorbed. Among the 72 subscribers were the leading men in the profession, including R. W. Raymond, James Douglas, A. R. Ledoux, Edward Peters, Anton Eilers, S. F. Emmons, James F. Kemp, J. Parke Channing, Ben B. Lawrence, F. W. Bradley, John Stanton, John B. Farish, D. W. Brunton, F. M. Taylor, J. E. Spurr, E. G. Stoiber, R. A. F. Penrose, H. V. Winchell, Arthur L. Collins, Walter McDermott, Franklin Guiterman, Arthur Winslow, Cortlandt E. Palmer, and A. G. Charleton. Johnston took all the common stock, for it was no purpose of mine to disturb his control as publisher. I asked him for 200 shares of common stock (which I valued then at about \$20 per share) as a commission for helping him to place the preferred. He demurred, whereupon I told him that he was lucky to be left with the control of the business, seeing that he had put only \$85,000 into it. Obviously, I could have obtained control of the 'Journal' at that time with a little financial by-play, but it would not have been fair to the man whose partner I had become. I endorsed a \$5000 note for him and lent him \$5000 besides. He was in a hole. I had many qualms, I must confess, for I had discovered that he had queer notions of business.

In October I left Denver and moved my household to Staten Island. Johnston and I completed the re-organization, and Mr. McGraw was paid off. This was done during the last days of the month. In the issue of November 1, 1902, it was stated that I was to become editor in January, and that a number of mining engineers had become shareholders, including 2 at Johannesburg, 2 in Australia, 8 in London, 4 in British Columbia, 4 at Butte, 5 in California, 2 at Salt Lake City, 5 in Mexico, 22 in various parts of Colorado, and the remainder in New York, Philadelphia, and Boston. In the issue of January 3, 1903, I made my salutation as editor, and all seemed serene. To tell the truth, at the start I found it irksome to have to write every week, and at first it was not easy to find fresh subjects. Up to that time applied geology, stamp-milling, the sampling of mines, and such matters had been my hobbies; now I found that I had to interest myself in all sorts of new activities and controversies. It gave me as much trouble to write a paragraph then as to write a column now; one has to serve an apprenticeship; most editors have been journalists; I was only a technical writer accustomed to preparing occasional contributions on subjects of my own selection. I had to learn quickly; and I did. My best helper was Hobart; he was an old hand, having been already 10 years with the 'Journal'. He was not an engineer and knew little about mining, but he understood the technique of editing and publishing most thoroughly, and was glad to have me as editor because he knew Rothwell would have approved. Hobart was a veteran of the Civil War, he was a steady and reliable associate editor, and to him the 'Journal' owes a good deal. He retired in 1917, after 24 years of editorial work, and died on March 9, 1919, at the age of 77. When I came to New York to be editor I expected to receive aid



had told me that he had bought it. During the ensuing months I finished my various professional engagements and cancelled my retainers as consulting engineer. In June (1902) I went to New York to make final arrangements. Upon my arrival, we discussed various plans, including a financial re-organization. To my chagrin, I found that Johnston still owed \$200,000 to McGraw, so that his position was precarious. Fearing a divided control, I suggested the issue of \$200,000 of preferred stock, offering to subscribe \$50,000 myself, if he would arrange to include the \$25,000 I had subscribed previously. On coming closer to realities, I found that Johnston's financial affairs were in a sad tangle; he was doing business 'on a shoe-string', but as I had become, in effect, his partner, I decided to stand by him. It was agreed that the Scientific Publishing Co., the corporation owning the 'Journal', should be re-organized with 2000 shares of preferred stock and 3000 shares of common, each to have a par value of \$100, making the total capitalization \$500,000. The earnings for the five preceding years had always been slightly in excess of \$24,000 per annum, so I felt warranted in offering the 2000 preferred shares at

and suggestion from that prince of technical editors, Dr. Raymond, but just at that time he was much in need of a rest and went to Europe for a holiday. During his absence I edited a number of the papers sent to him as secretary of the American Institute of Mining Engineers, and in return, as an honorarium, I received a number of back volumes of the Transactions. When he returned, in the summer of 1903, he spoke of my amateurish efforts as editor of the 'Journal' and said that they were "bully". Soon afterward I had to decline a series of articles by him on the controversy over Dr. B. E. Fernow and the New York State College of Forestry,² and this, to my great regret, caused a coolness that prevented me from asking him for help; but it did not interrupt our friendship.

Our board of directors consisted of five. Mr. Johnston, his son Edwin, and his lawyer (Arthur Palmer) represented the common stock. Dr. Raymond and I represented the preferred stock. When the Doctor went to Europe, Theodore Dwight, his nephew and assistant, filled his place as director. We had hardly established the new organization, in December 1902, when Johnston went to San Francisco, to look after the affairs of the 'Pacific Coast Miner'. He had bought this inconsequential paper from Willard P. Calkins and Thomas D. Calkins. Unable to secure a permanent editor, he had pressed Charles G. Yale, then San Francisco correspondent of the 'Journal', and for 23 years editor of the 'Mining and Scientific Press', into the breach, much against Mr. Yale's wishes. In the January 3 (1903) issue of the 'Journal', there appeared an 'Announcement' stating that Mr. Johnston had purchased the 'Pacific Coast Miner', "which will hereafter be published every Saturday as a separate paper by a separate company, but under a close working arrangement with the 'Engineering and Mining Journal'". It was stated also that Mr. Yale and J. O. Denny were to be the editors of this "new paper". I do not know why I allowed this to appear on an editorial page; at that time I had no idea of the complications that were to ensue. Johnston was a persuasive man and persistent; it was hard to refuse him politely. In the contemporaneous issue of the 'Pacific Coast Miner' he allowed himself more scope for verbal inexactitudes. On the editorial page, which, however, bore no editor's name, it was stated: "Both the editorial staff and the business staff have been strengthened by combining on the one paper the forces of the 'Engineering and Mining Journal' and of the 'Pacific Coast Miner'". This was rot, unless he referred to himself as the "forces". We in New York knew nothing about any such arrangement. Next: "The Pacific Coast editor of the 'Journal' joins hands with the editor of the 'Pacific Coast Miner', and both work together—with the cordial and active co-operation and assistance of the editors and special contributors—to produce a periodical that creditably represents the great mining and metallurgical industries of [here followed a list of the Western States] and Old Mexico." I can say unreservedly that "the editors and special contributors",

so airily dragged into this wild-cat publication, knew nothing whatever about the intimate co-operation so positively announced. Johnston's statement, of which Mr. Dwight and I were not aware, as we did not see any copies of the 'Miner' in New York, was unauthorized, improper, and untruthful. His name appeared as President and General Manager. To complete the story, I must quote his description of his own performance, as printed in the same issue of the 'Miner'. It read thus: "After the death of Mr. Rothwell he [that is, Johnston] purchased the 'Engineering and Mining Journal' [he bought it from McGraw after Rothwell had refused to sell it to him] and a year ago merged the two periodicals [the reference being to the 'Mining and Metallurgical Journal' of Los Angeles, which he had bought in 1900]. Since then the net gain in circulation has been just about twice what it formerly was. In addition, the advertising of the



consolidated publication is not only greater than was the aggregate advertising in both papers, but it is fully double the volume that the 'Journal' was carrying at the time of the consolidation." This was characteristic, as I found later; it was an irresponsible exaggeration verging closely upon a glaring untruth, as could be discovered by anybody sufficiently curious to count the actual pages of advertising carried by the 'Journal' at the two periods. These facts have to be stated in order to throw light on the extraordinary tangle into which Johnston plunged the affairs of the 'Journal', and to explain the fracas into which he pulled me.

Mr. Yale attended to the editing of three or four issues of the 'Miner'. Then Louis Janin Jr. became editor, although his name did not appear on the title-page. Mr. Janin came of a family distinguished in the history of American mining and gave promise at one time of a distinguished career on his own account; he had been on Rothwell's staff for a few years, and if prohibition had been antedated, say, 25 years, he would have taken a high place in technology. He is now in a sanitarium in Southern California.

Johnston had an idea, like most of the New York publishers, of controlling a string of papers. So he bought

²'Reminiscences of R. W. Raymond', by T. A. R. 'M. & S. P.', October 11, 1919.

the 'Miner' in San Francisco, and hoped to start another paper in Chicago. He tried several times to buy the 'Mining and Scientific Press', Mr. Halloran tells me. All this he was doing or expected to do without adequate capital. While he was away in San Francisco I discovered, to my horror, that he had used already \$21,000 of 'Journal' money in nourishing the 'Miner'. He telegraphed for a further remittance and our business manager, J. T. Morris, informed me of the fact. The remittance was not sent. Upon mentioning the matter to Mr. Dwight, my co-director, he expressed astonishment, if not dismay. We awaited Johnston's return and then told him that he had no right to use the funds of the 'Journal' in building up a paper in which we had no interest and which in some respects was already a competitor. In order to avoid a personal quarrel, I obtained Johnston's acquiescence to the nomination of a committee of investigation. This committee consisted of the late John Stanton,^a a man of the highest standing and prominent in Lake Superior copper mining, Benjamin B. Lawrence, a mining engineer of distinction and now a trustee of Columbia University, and Charles E. Lydecker, then major of the Seventh Regiment and a friend of Mr. Dwight, who himself was in the Seventh Regiment. Major Lydecker, being a lawyer, was of much value in the contingency that had arisen. This committee took a serious view of Johnston's misuse of funds and wanted to prosecute him, but to this step I was strongly opposed, because it would involve the 'Journal' in a public scandal and it would bring trouble upon Johnston's family, whom I knew and liked; moreover, I believed Johnston to be an honest man, but afflicted with queer notions of business; he might be considered lacking in a sense of honor, but he was not dishonest. In the end we settled the matter by compelling Johnston to sign a note for the misappropriated money, the note being secured by 1000 shares of common stock. This gave our party—the preferred shareholders—the control; so we placed Major Lydecker on the board of directors in place of Johnston's son. This was in April 1903. We allowed Johnston to remain president of the company, but the actual control of affairs at this time had passed largely into the hands of Mr. Morris and myself. Luckily for the 'Journal', Mr. Morris was an excellent business manager and supervised the publishing and advertising departments with marked ability during Johnston's alarms and excursions; otherwise we would have been in a bad way.* We were barely able to pay the first quarterly dividend on the preferred stock, on April 1, 1903, on account of the money sent to San Francisco, but the paper was gaining ground and was making increased profits, so we escaped the necessity for telling the preferred stockholders about our troubles. This was a wretched time for me; it was difficult to do my work as an editor, because I never knew from day to day what new difficulty I might have to face in consequence of Johnston's vagaries.

At about this time (probably in June) I received an invitation from Dr. Day to meet him and Mr. McGraw at luncheon at the Engineers Club. Until then I had not made Mr. McGraw's acquaintance. These gentlemen, it appeared in the course of conversation, wanted me to throw Johnston overboard and join them in a new scheme to run the 'Journal'. During Day's absence from the room, I took the opportunity of telling McGraw that I could not see where Day would 'come in' and that I did not care to work with him, but that, of course, I was aware of his own (McGraw's) prestige and ability as a publisher. Day came back to the table, and I then told both of them that although Johnston had broken faith with me and done many queer things, I still felt myself



bound to regard him as my partner and to help him out of the mess in which he had got himself; so I declined their "flattering proposal".

After the settlement in April, we seemed to have sailed into smooth waters, but very soon I found that Johnston was using our lists of possible subscribers and our advertising clientele for the purpose of getting subscribers and advertisements for the 'Pacific Coast Miner'. He promised to cease doing so, but broke his promise; he denied it, and we proved it. Here was another mess. The directors, that is, the three in the majority, insisted that Johnston should get rid of the 'Miner'. We had some stormy meetings. Johnston was in a bad way financially. My friends Dwight and Lawrence thought the time had come to obtain control of the 'Journal' for the mining engineers. We offered him \$50 per share for his common stock; he declined. I suggested that an appraisal be made by three representatives of the publishing business in New York. He agreed. We selected F. P. Burt, manager of the 'Engineering News' and John R. Dunlap, owner of the 'Engineering Magazine'. He nominated E. C. Brown, owner and editor of the 'Progressive Age'. These three agreed to serve as a committee, and in due course, after examining the books of the 'Journal', they reported that \$40 per share was a fair price. Johnston said it was too low and refused to abide by his agreement to accept the appraisal. He told us we could sue him. Again I declined to sanction litigation, because it would entail a scandal. Moreover, I thought myself that \$40 was a low valuation; it was my opinion that the committee on appraisal had allowed their personal distaste for Johnston's methods to prejudice their judgment. Johnston assured me that he could get \$60 for the common shares, whereupon I said that we would give him 60 days

^aHe died, greatly respected, on February 23, 1906.

*Mr. Morris is now treasurer for 'Public Works', a New York publication devoted to municipal engineering and kindred operations.

to sell at \$60, on condition that if he failed we could have 30 days to buy at \$50. He agreed. This was in November 1903. Here I must note the fact that Johnston's contract with me stipulated that I was to have complete control of the editorial department, so that I was entirely independent as editor, and he had agreed also in the contract not to sell his common shares to anybody of whom I disapproved. I was willing to work with him (when I signed the contract in 1902), but not with any speculator to whom he might sell out. So I had a veto.

The first to offer to buy Johnston's interest was John A. Hill, the publisher of 'Power' and the 'American Ma-

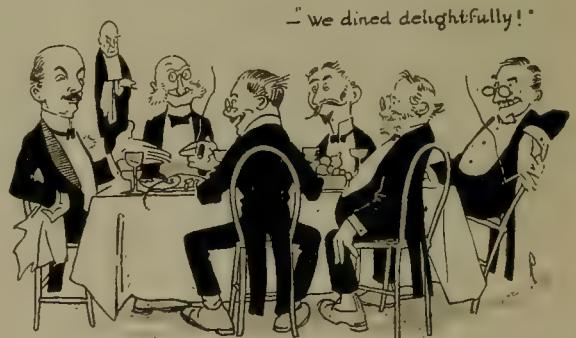


"he wore a handsome fur coat and an engaging manner"

chinist'. We lunched together at the Hardware Club and had a couple of conferences. I satisfied myself that he was an able man, a strong character, a man of the highest integrity, but rough and overbearing. He was not a man with whom I could work comfortably, and I told him so. He retired. Next came Louis Cassier, of 'Cassier's Magazine'. He wore a handsome fur coat and had an engaging manner. He took me to a bank and I soon found that he expected me in some way to aid him in financing his proposed purchase of Johnston's stock. I declined to do so. My friend Lawrence made a bet of a dinner for ten that nobody would buy at \$60, and I surmised that he counted upon the persistent use of my veto. Presumably I could have used it to the end of the chapter and euchred poor Johnston out of \$10 per share, that is \$30,000, but I intended to 'play fair', and I had another thought at the back of my head. It was this: during the previous months the control of the paper in large measure had been in the hands of a committee of mining engineers; we had discussed the project of vesting the ownership entirely among members of the profession, which meant that the directorate would consist of representative engineers. I had begun to discern the difficulty of being the editor of a mining paper when the publishers, that is, the directors of the publishing company, were mining engineers. It meant that a small clique would be in control, and they would expect the editor to give heed to their notions of an editorial policy. My idea had been that an experienced publisher should run the business end of the paper and I should be an independent editor, that is, free

from dictation as to policy, always supposing that the policy was not suicidal to the prosperity of the paper as a business. That was why I was willing to leave Johnston in control even after I had found that he had put so little money into the venture, and that was why now I looked with no pleasure to a failure on his part to sell his common stock, and his control as publisher, to a suitable substitute. I accepted Lawrence's bet, believing that the right man would show up. He did. A few days later H. M. Swetland made a proffer of purchase. We had several conferences and lunched together. I found him quiet, sagacious, and frank. He was then publishing the 'Automobile' and two other less important papers. Originally a school-teacher, like Mr. McGraw, he had been manager of 'Power' and the 'Street Railway Journal' in 1886 and sole owner of 'Power' in 1888, becoming associated with Hill from then to 1902. With McGraw and Hill, he had had dealings in the buying and selling of trade papers in New York. They were speculative publishers. Hill was forceful, McGraw shrewd, and Swetland sagacious. I told Mr. Swetland that he was acceptable. Lawrence lost his bet, we dined delightfully with eight others, including S. F. Emmons and James F. Kemp, at the University Club, and Johnston transferred his stock to Swetland. The announcement of the change was made in the 'Journal' of January 21, 1904.

In July 1904 Johnston started a monthly publication



"we dined delightfully!"

called 'The Mining Magazine' with H. Foster Bain as editor. On the title-page it was stated, "with which is incorporated the 'Pacific Coast Miner'". This magazine must not be confused with the one started in London five years later, although it is noteworthy that Mr. Bain was editor at various times both of the one in New York and of the one in London. Johnston's 'Mining Magazine' ceased to be published in June 1906,⁵ when it was bought by John A. Hill and incorporated with the 'Engineering and Mining Journal'.

The transfer of Johnston's stock to Swetland was a great relief to me. Then followed a pleasant time. Mr. Swetland and I worked together with complete harmony.

⁵W. J. Johnston died on April 28, 1907. He was born in the north of Ireland in 1853 and started life as a telegraph operator. His first journalistic venture was 'The Operator', a paper published for employees of the Western Union Telegraph Co. When electricity came into use 'The Operator' became the 'Electrical World'.

⁴He was killed in a railroad accident near Salisbury, England, while on his way from New York to London, in 1905.

I had the fullest confidence in his sagacity and for the first time was able to attend to my editorial duties without fussing with the business administration. The paper prospered; in July we declared a 5% dividend on the common, as well as the usual 2% quarterly dividend on the preferred. But a fresh break was imminent. On the morning after Thanksgiving day, Mr. Swetland came into my office and told me that he had tried to reach me on the telephone the day before and the evening before that, in order to inform me of his negotiations with Mr. Hill. "At 10 o'clock this morning I shall transfer all my stock in the 'Engineering and Mining Journal' to Mr. Hill", he said. "I hope you don't blame me," he added. "Not at all," I replied. "What do you get?" "90 per share," he answered. "Let me see," I replied, "you have received a \$15,000 dividend on your stock, so you have made \$105,000⁶ in nine months. To you it is a matter of business, you have not been with the 'Journal' long enough to have any particular sentiment for it; I don't blame you at all, I congratulate you heartily, but I want to express my keen personal regret that you are going." Not long before, he and I had discussed a purchase of preferred stock by him and of common stock by me, so that our interests might be drawn together, otherwise my policy as a director was inclined to be too conservative, having an eye mainly to the safety of the preferred stock. He had offered me an option on the 200 shares of common that he had bought from me at \$60 when Johnston sold out and I had accepted the option. So, when he announced his sale to Hill, he told me that, of course, it included my 200 shares, on which he would be glad to pay me the difference of \$30 per share. This was right and proper, but everybody does not do what is right and proper amid this flux of phenomena called life, and I appreciated his straightforward action, which was characteristic. Looking back, I regard the departure of Mr. Swetland as a definite misfortune to the 'Journal' and to me. As I have said already, I did not want to be bothered with the publishing end of the business; I wanted only to be an independent editor working in harmony with a capable and trustworthy publisher. Of course, I could have obtained control of the 'Journal' easily during Johnston's aberrancies. The bank asked me how his credit stood; a shrug of the shoulders would have sufficed to shake him out of his precarious position; instead, I endorsed his note at the bank. Only when he proved impossible did I join with my co-directors in facilitating his exit. Mr. Swetland was just the man I wanted for publisher; we worked together charmingly. If he had remained, I might be in New York today. Since then he has proved his unusual ability and has prospered exceedingly, as he deserved.⁷

In due course Mr. Hill made his appearance. After a pleasant greeting, he said, "There will be no changes".

⁶This, of course, included the advance of \$30 per share on the 3000 shares of common stock.

⁷He is now president of the United Publishers Corporation, which owns 16 papers, including the 'Iron Age', 'Hardware Age', 'Automotive Industries', 'Motor Age', 'Motor World', 'Dry Goods Economist', and 'Lumber'.

This I took to mean that he would not make the changes he had indicated in the course of our conversation the year before, when he had been negotiating for the purchase of Johnston's stock; his remark did not refer to my position as editor, because that was still protected by my five-year contract with the company. Mr. Hill assumed control and soon disclosed his intention to do many things of which I had expressed disapproval to him, such as moving the office of the paper to a large building in the slums, the old Five Points, and consolidating our quarters with those of the other papers that he controlled. I had told him that the supporters of the 'Journal' would not like to see it syndicated and would not wish its identity to be merged in any way with a nondescript publishing business. At the meeting of our directors, Mr. Hill took the upper hand unmistakably and bluntly; if either Mr. Dwight or I had anything to say, he would lay down the law roughly. "What are you going to do about it?" was his retort. He was the boss; he looked upon the preferred stockholders as a nuisance. Soon he suggested dropping the names of our 'Special Contributors', whereupon I informed Mr. Morris,



through whom the proposal was transmitted, that such a change could be made only with my consent, because it affected the editorial department, and that Mr. Hill had better "keep off the grass". In short, we were mutually antagonistic; he regarded editors as necessary evils; I regarded speculative publishers in the same light. To have dropped the names of the 'Special Contributors' would have been offensive to Dr. Raymond, more particularly, but also to others. In November 1904 the names of the following 'Special Contributors' appeared at the masthead of the 'Journal':

R. W. Raymond.....	New York
J. Parke Channing.....	" "
John A. Church.....	" "
Robert T. Hill.....	" "
D. H. Newland.....	" "
Joseph Struthers.....	" "
W. R. Ingalls.....	Boston
Edward D. Peters.....	"
F. Lynwood Garrison.....	Philadelphia

R. A. F. Penrose, Jr.	“
S. F. Emmons	Washington
Edward W. Parker	“
J. E. Spurr	“
W. H. Weed	“
W. N. Page	Austed, W. Va.
Robert V. Norris	Wilkes-Barre, Pa.
Philip Argall	Denver
Chester W. Purington	“
R. Gilman Brown	San Francisco
Charles G. Yale	“ “
A. G. Charleton	London
Henry F. Collins	“
J. H. Curle	“
T. Kirke Rose	“
T. Lane Carter	South Africa
G. A. Denny	“ “
Donald Clark	Australia
F. Danvers Power	“

Those who know will agree that this was a representative list; it indicated the support of the best element in the profession; it served to emphasize the fact that the 'Journal' had become the organ of the mining profession. Early in February I went to London to attend the annual dinner of my fellow alumni of the Royal School of Mines and while there my friends H. C. Hoover and J. H. Curle suggested that I should get hold of the London 'Mining Journal'; but the idea did not attract me, because mining journalism in London suffered, and still suffers, from the patronage of the promoter and the bribery of the financier. I returned to New York and resumed my work, but without enthusiasm.

At this time Jacob Langeloth, president of the American Metal Company, offered to lend me \$300,000 at 6% to buy out Hill.⁸ Mr. Langeloth had been a friend of Rothwell, and I inherited that goodwill, as it were, when I became editor. In those days we did not look upon our German friends of the American Metal Company, even if they were closely connected with the Frankfurt Metallgesellschaft, as the tentacles of a metal octopus; quite the contrary, for many years the metal quotations of the 'Journal' were obtained by Hobart, who had charge of that department, in the course of a visit each Wednesday to our friends at 52 Broadway. I knew Langeloth only as an old friend of Rothwell, and as a kind and courteous gentleman with whom I lunched occasionally, and to whom I related the queer things that had been happening in the course of our troubles with Johnston. When Mr. Langeloth offered to lend me the money to buy out Hill, I had reason to know that the common stock was earning more than 10%, and therefore that after paying the 6% on the loan there would be a margin of 4%, which would be increased if the 'Journal' prospered, as seemed likely. On the other hand, I disliked the idea of incurring so large a liability and of placing myself as editor under such a financial obligation to anybody; so I declined the proposal.⁹

In March 1905 the government of Nova Scotia asked

me to report upon the gold-mining industry of that Province. This meant an examination and report, which was contrary to my self-imposed rule not to practise as an engineer while acting as an editor; so I declined the engagement. My position became increasingly uncongenial; early in April I asked Mr. Morris to tell Mr. Hill that it was advisable in his interest and mine that I should resign, as I had begun to realize a loss of enthusiasm for my work. I intimated that I would do my best, in good faith, until the end of the current volume, that is, to June 30. Each volume included the issues for half a year. Mr. Hill agreed to my resignation, not without courteous protest.⁹

At this period I had already begun to turn my eyes to California, thinking of the 'Mining and Scientific Press' as offering a suitable field for activities that I had learned to enjoy. I had served an apprenticeship of 2½ years on the 'Journal'; I liked the work of editor, and the work seemed to like me. By this time I had made up my mind not to put myself in the position of being transferred like a bushel of potatoes every time that one speculative publisher sold out to another of the same group. Like most educated men, I was willing to work with a competent associate, but I was not willing to be bossed by an uncongenial person, especially one lacking the amenities so necessary to pleasant co-operation. London did not attract me; I did not like the climate; I liked the American way of doing and saying things; and the sinister relationship between mining finance and mining journalism in the British metropolis seemed detrimental to the only kind of journalism for which I cared. So I thought of the 'Mining and Scientific Press'. It was, and always had been, a clean paper. J. F. Halloran, the owner and publisher of it, was known to me pleasantly; I had contributed more than once to the 'Press' when I lived in Colorado, and I believed that Mr. Halloran would regard an offer from me favorably. Besides, the idea of living in California, particularly at Berkeley, was attractive. I had been in charge of a gold mine (the Rathgeb or 'Union Consolidated' property, near San Andreas) in Calaveras county from 1887 to 1889 and I had examined mines in other parts of the State in later years, so I knew something about local conditions on the Coast. My grandfather, James Rickard, had come to California in 1850 to examine the Mariposa estate and he had erected the first stamp-mill in California. This was a sectional plant brought by him across the isthmus of Panama from Cornwall and erected near Coulterville, in order to test the ore of the southern end of the Mother Lode. He made the examination for John Taylor & Sons, a firm still honorably prominent in London, on an option held by General John C. Frémont, the Pathfinder, and candidate for the Presidency of the United States in 1856. Capt. James Rickard, as he was called, being a senior mine captain, reported adversely on the Mariposa grant, after an investigation that lasted six months. My uncle, Reuben Rickard, had been president of the town council of Berkeley in 1888, and his son, Thomas Rickard,

⁸Mr. Langeloth died on August 14, 1914.

⁹John A. Hill died on January 24, 1916.

was elected mayor of Berkeley in 1905, so I had many pleasant ties to draw me to California. Therefore I wrote to my friend Ben S. Revett, the specialist in alluvial mining, then sojourning in San Francisco, and asked him to interview Mr. Halloran in regard to a possible deal. He found Mr. Halloran rather coy; in the first place, the publisher of the 'M. & S. P.' was sceptical as to my ability to find the necessary money and suspected that I represented some syndicate or group; he did not know that during my years of professional practice in mining I had done so well, although, of course, my earnings were small as compared with those of successful engineers nowadays. However, Mr. Halloran expressed willingness to deal with me personally and suggested that I meet him in San Francisco. That was impossible, because I had to attend to my duties on the 'Journal', so we compromised, and I agreed to meet him at Chicago. This I could do without losing any time.



"the whole deal was Western!"

It happened that the American Institute of Mining Engineers held a meeting at Washington on May 2 and the following four days. I went to Washington, where my wife and I were guests of Mr. and Mrs. A. A. Blow, old Colorado friends. The meeting ended on Friday, and on the afternoon of that day I went to Chicago, meeting Mr. Halloran on Saturday evening, May 6, 1905. I reached New York on Monday morning, so that nobody in the 'Journal' office knew that I had been to Chicago.

Mr. Halloran and I did not take long to make a deal, for both of us knew what we wanted to do. He asked me how I based my valuation of the 'Press', and I said upon the average earnings of the previous five years capitalized on a basis of 15%. He told me what the earnings had been and I offered him \$121,000 for his two-thirds of the stock, this being based, if I remember correctly, on average annual profits of \$24,000. He asked \$125,000, and I agreed. He said that I must put up \$10,000 then and there, and I agreed to do that. Then I told him that, of course, I would like, as a formality, to have the books of the Dewey Publishing Co., in which the ownership of the 'Press' was vested, examined in due course by an accountant. "If there should be any inadvertent error in your figures of the earnings, what happens to my \$10,000?" I asked. "You forfeit it," he replied. To which I retorted: "Oh, I see, you want me to bet \$10,000 that J. F. Halloran is an honest man; I'll make the bet." This was Western.

So was the whole deal. At the back of my head, besides confidence in Halloran's good faith, was an idea that if anybody got \$10,000 out of me on a mis-statement, I could recover. He asked whether I wanted a lawyer to draw up our agreement; I said "No; you draw it up". He did; I accepted it; we went to a notary in the hotel, Halloran paid him 25 cents, and the deal was consummated. Further payments were due in July and November. Halloran held two-thirds of the 750 shares, of \$100 each, for which the company was capitalized; the other third belonged to a very old man, Warren B. Ewer. It may be best at this point in the story to state what happened to that interest. On my arrival in San Francisco I tried to buy it, through Ewer's representative, a lawyer named C. E. Naylor, but I was informed that Mr. Ewer had confidence in my control and did not wish to sell. I feared some speculator, uncongenial to me, might buy the stock, so I told Mr. Naylor that I disliked having a sleeping partner and would feel justified in taking a large salary. After protracted negotiations, ending in March 1906, I bought the Ewer third for \$75,000, of which \$15,000 was in cash and \$60,000 on a note at 8%. Mr. Ewer declined to sell for cash, so that was the best I could do.

I have not finished my account of the negotiations with Mr. Halloran at Chicago. I told him of my distaste for doing anything spectacular, such as leaving the editorship of the 'Journal' one week and assuming that of the 'Press' the next week; I desired a decent interval to elapse; in short, I wanted him to continue in charge of the 'M. & S. P.' I asked him what salary he was paying himself; he said \$100 per week, whereupon I told him that I would be much obliged to him if he would continue to run the paper for the rest of the year (eight months) as if nothing had happened. He agreed. I returned to New York. Mr. Hill asked me to suggest a successor; and I told him that W. R. Ingalls was the logical man. Mr. Ingalls had been the most voluminous and most valued contributor, outside the staff, for several years, and he had kept so close a touch on world-wide progress in metallurgy, more particularly, that evidently he was the man to appoint. As he lived on Staten Island, not far from me, I walked over to his house one afternoon in May and told him of the impending changes, much to his surprise.

Immediately after I left the 'Journal', Mr. Hill ceased to print the list of Special Contributors on the first editorial page and proceeded to buy the preferred stock. I sold mine at \$105; all my friends obtained par or better for their shares, some as much as \$112.80. Mr. Hill succeeded in buying the whole of the preferred stock, indicating thereby the low value he set on the direct support of the profession. The 'Journal' ceased to be the organ of the mining profession and became one of a syndicated group of trade papers.

My valedictory—a short one—appeared in the 'Journal' of June 29, 1905. A few days later I went to Halifax, for, as soon as my resignation as editor became known, the invitation to make a report on the gold-mining industry of Nova Scotia was renewed. I made a

preliminary inspection and agreed to do the work in August. Then I went to San Francisco to see Mr. Halloran and make the second payment on the 'M. & S. P.' Everything went smoothly. I spent August and part of September in Nova Scotia. Early in October I went to Mexico, spending four weeks on visits to El Oro, Pachuca, and Guanajuato, as recorded in 'Journeys of Observation'. On November 10 I reached Berkeley, whither my wife and children had preceded me, establishing themselves in a house that I had selected and leased when in California during the previous July.

While at Guanajuato I received a telegram from my cousin, Edgar Rickard, who had just returned to Berkeley from Baja California, Mexico. He said that he had heard of my purchase of the 'Press' and offered to be business manager. I replied that I would be glad to have him, if we could agree on terms. We did, readily. He had been associated with me in my professional practice when in Colorado. He was a graduate of the University of California and had a host of friends in San Francisco. He took charge of the business department of the 'M. & S. P.' on December 1. At that date Mr. Halloran resigned as president of the company in my favor and Edgar became director in lieu of Harry Durbrow. On that day I informed Mr. Halloran that my friend William Hanson (manager of the California Wine Association) had examined the books and reported that, although the statement as to earnings was approximately correct, the accounts showed that the cash on hand at the end of the five-year period was less than at the beginning, so that the earnings of the paper during that period actually were a little less than the figure given to me by Mr. Halloran. Whereupon Mr. Halloran began to say something, but I interrupted him by stating that I had only mentioned the matter in order to show my knowledge of the fact and to emphasize my satisfaction with the deal, more particularly the manner in which he had performed his part, in managing the paper with such sincerity in my behalf during the preceding months. We then shook hands cordially. Just as we finished the transfer of the property, an earthquake shook the building, at 330 Market street. Mr. Halloran exclaimed jocularly: "That always happens when the 'Mining and Scientific Press' is transferred." On April 18, 1906, San Francisco was shaken by a severe earthquake and devastated by a conflagration that lasted three days and three nights. The entire plant of the 'Press' was destroyed. I was paying 8% on the \$60,000 note to Ewer. Things looked black; but not for long. We were soon on our feet again.

The earthquake arrived at 5:13 in the morning; by noon we knew that our offices and plant had been destroyed; but we had the essential asset, our subscription-list; the one for that week Edgar R. had taken home with him the night before and the list for the previous week was at my own house. All we needed was an office and a printing-press. By three o'clock that afternoon we had leased a suite of rooms in the new building of the First National Bank at Berkeley, where both of us were living, across the bay from San Francisco, and two hours

later Edgar R. had arranged for the setting of type and the printing of the 'Press' by a local newspaper, called 'The Reporter'. We bought some furniture and engaged a number of refugee girls to address envelopes, for we anticipated that for a time nothing would go forward except by first-class mail. We bought the whole stock of stamped envelopes at the Berkeley post-office. Early that morning, while waiting to join forces with Edgar R., I had written an article on earthquakes and



had it ready for publication. The earthquake was on Wednesday; the burning of San Francisco continued until Saturday; an emergency issue of the 'Press' (dated April 21) was posted at 5 p.m. on Friday, April 20, so that just when all our subscribers thought the paper was 'down and out' they received a cheerful greeting. We never missed an issue! The next one, that of April 28, was of regular size, but it was unusually interesting on account of various illustrated articles on the earthquake, besides the usual quota of mining news and technical information.¹⁰ We were weeks, even months, ahead of other publications in San Francisco. The reader will forgive this boasting! 'The Reporter' cinched us, but not so badly as the Oakland 'Tribune', which charged us five times the usual price for half-tones; so we had them made for us at Sacramento, Los Angeles, even Chicago, until the engraving establishments in San Francisco got to work again. In July we had our own composing-room once more, in Berkeley, and in September we began to have our printing done in San Francisco, sending the 'forms' to the Stanley-Taylor Company by automobile and ferry 12 miles across the Bay. At the end of April 1907 we moved back to the City, with quarters in a little brick building at 667 Howard street, amid the dust of ruins and the din of reconstruction. A year later, in May 1908, we sold 'The Rural Press', a paper devoted to the industry of agriculture and a younger brother of the 'Mining and Scientific Press', having been founded by A. T. Dewey and Warren B. Ewer in 1871. Edgar R. and I took no interest in it, and were glad to sell it for \$4000 to Frank Honeywell. With the proceeds we bought a linotype machine. Up to that time, May 1908,

¹⁰A full account of those exciting days will be found in my article 'The Earthquake Fire', published in our 50th Anniversary number of May 21, 1910.

our type had been set by hand. In August 1911, the 'Press' moved to its present offices, at 420 Market street. That ended the migrations caused by the earthquake-fire of 1906. Reverting to that event, I may state that we had paid a 2½% dividend four days before the catastrophe. I had invited half a dozen friends to become shareholders. One of them was H. Foster Bain, then State Geologist of Illinois. In my first mail after the earthquake I found a check for \$500 from him. That looked large just then, for all our local banks were closed. I wrote back to him saying that under the altered circumstances of the 'Press', he would probably like to withdraw his subscription and I would return his check. He replied promptly saying that he would take his chances. Three years later (on April 3, 1909), he became associate editor of the 'Press'.

A year earlier Courtenay DeKalb joined me as associate editor, and when I went to London in 1909 he and Mr. Bain became joint editors of the 'Press', until Mr. DeKalb resigned in July 1910. After that Mr. Bain was the editor until my return in March 1915. Mr. Bain is a facile and agreeable writer, and a man rich in friends. Mr. DeKalb was, I believe, the most scientific and literary man ever on the editorial staff of any mining paper. As an example of his style, I like to recall the editorial entitled 'The Curse of Potosi', published in the 'Press' of July 4, 1908. In that editorial will be found his characteristics: fluent diffuseness, literary charm, sympathy with the Latin races, knowledge of South America, all commingled in producing a kind of writing rare indeed in technical publications. Mr. DeKalb rejoined me in March 1917, remaining as associate editor until he went to Spain on a special mission for the Department of Commerce in March 1919.

Early in 1909 I was urged by sundry friends in London, some of them Americans, to start a real mining paper in that city. Edgar Rickard thought it a good idea. It promised to be an interesting adventure. The 'Press' seemed to be firmly on its feet and doing well. DeKalb and Bain were associate editors, and I felt that they could conduct the editorial department satisfactorily. Edgar R. chose Lester A. Greene, our agent in Chicago, to succeed him as manager in San Francisco. In March 1909 I asked Edgar R. to go to London and ascertain for himself what were the conditions affecting publishing, such as the cost of paper and of printing, so that we might know what factors were favorable. As for the editing, I believed that the conditions would be much the same as in San Francisco and New York, except that the centralization of the British mining business in London would make it easier than in either of the American cities. He went and came back within six weeks, bringing a favorable report. We decided to make the venture. Together, with our families, we left California on May 7 and reached London on June 5. Two months were spent in preliminaries. Before our arrival we had decided to publish a monthly magazine and had arranged with Edward Walker, London correspondent of the 'M. & S. P.', to issue a sheet under that name so as to hold the title. We found that others, to block us, had registered

the name 'Mining and Scientific' and one or two other likely names, in anticipation.

On September 15 the first issue of 'The Mining Magazine' appeared. In size and general appearance it looked American; we used calendered paper, plenty of illustrations, excellent printing, and an outspoken style in the editorial utterances, of which there were many. Seven pages of 'Review of Mining' were followed by 14 pages of 'Editorial'. Then came 12 pages of 'Special Correspondence' from Johannesburg, Mexico, San Francisco, Denver, New York, and Cornwall. Two pages of 'Discussion' followed. Among the articles was one by H. C. Hoover, written under the pseudonym of 'A Professional Speculator'. It appraised a number of representative mining shares and created a great deal of comment. J. H. Curle wrote on 'West African Mines', H. F. Collins on 'Sintering of Copper in Spain', and T. Lane Carter on the 'Metallurgy of the Rand'. It is interesting to note that this first issue contained a technical description of the first flight across the Channel by Louis Bleriot, for which I had obtained details from A. E. Berriman, now recognized as a leading authority on aviation. At that time he was editor of 'Flight'.

This first issue was well received, but one or two of our friends suggested that the standard was too high to be maintained. Yet we improved upon it. The 'Magazine' was on its feet and earning a profit within a year; it was a successful venture, but never a large business. It was capitalized for 15,000 £1 shares of 6% preferred, of which only 13,000 were issued and only 10 shillings per share called up, so that we started with a working capital of £6500, of which only £4200, say, \$20,000, was used in establishing the magazine. I subscribed for 5000 of the preferred stock and Edgar for 2000, the remainder being distributed in small holdings among 30 mining engineers, the leaders of the profession, including several Americans resident in London at that time. The common stock, 10,000 shares of £1 each, was divided between Edgar and me. Within three years the magazine paid 10% per annum on the common stock, as well as 6% on the preferred, but even at that the earnings were small. The business never began to compare in importance with either of the two American mining papers. In 1913 I thought of retiring as editor, and even went so far as to negotiate with Ralph Stokes to succeed me. He had been our correspondent at Johannesburg and was one of the few engineers possessed of the kind of critical faculty needed for editorial work; besides, he was a man of quick wit and wide experience. He decided to stick to engineering work and joined W. W. Mein in New York. As soon as England declared war he enlisted, and served with great distinction, rising to the rank of Lieutenant-Colonel and winning several medals for courage and skill. At the beginning of 1914, Edgar Rickard, who had become a close friend of Herbert Hoover, was offered a directorship in one of Mr. Hoover's companies, but when I pointed out that it would entail his resignation as business manager of the 'Magazine', he declined the offer.

The curse of technical journalism in London is its

intimacy with company finance. Most of the papers live largely on company meetings, that is, the payment they receive for publishing reports of the proceedings, more particularly the chairman's speech, at the annual meetings. Usually they are published in the body of the reading-matter like *bona fide* news, but they are printed at the advertising rate, if not a higher one. When we started the 'Magazine' we made it a rule that a company meeting should appear as advertising matter, as indeed it was, because we were paid for it. We charged exactly the same rate for it as for an advertisement of machinery. Even when treated frankly, this sort of business is a sop to Cerberus; it still serves a sinister purpose, because any editorial criticism of the management of a company is likely to be followed by a cancellation or withholding of the order for the advertising space required in reporting the next meeting of the company or of one in the same group. I used to attend the more important of these annual meetings myself and write editorials on them, describing the incidents and recording impressions as if I were telling somebody at a distance what really happened. That was real journalism; I ignored the accounts given by the secretary of the company to the press; I told the true story, which often happened to be amusing as well as significant. As an example of the sort of thing that happened, I may mention the annual meeting of the Consolidated Gold Fields of South Africa in 1913. Several attacks were made by shareholders against the board of directors, but they were poorly delivered. The Gold Fields people had been doing some shady business in share speculation. I said editorially: "Lord Harris took the unction to his soul that he and his colleagues were acknowledged as fair and honorable in their corporate dealings in mines. We happen to know that the general opinion of the mining profession, particularly those acquainted with the performance of the Gold Fields in Rhodesia and Nigeria, is nothing like so kindly." This was true, and it was said in the public interest. A few days after our issue of December 1913 had appeared I received a call from the secretary of the Lena Goldfields, another of the companies of which Lord Harris was chairman; he upbraided me for giving offence to my "friends" and at the same time cancelled an order for 3½ pages (worth £35) for a report of the Lena Goldfields meeting. I told him that by "friends" he must mean 'patrons', that he entirely misunderstood our kind of journalism, which depended for its financial success not upon the patronage of promoters, but upon the fact that it was read by the mining engineers who placed the orders for the machinery that was offered for sale in our advertising pages; in other words, it was a medium of publicity for manufacturers, not a dependent of the *haute finance* of stock-jobbery. This is the sort of thing that mining journalism in London has to face; the gutter press of London lives on it; the best papers have to take cognizance of it; it has been the bane of mining journalism, and apparently will continue to be so. Since I severed my connection with the 'Mining Magazine' that publication has been obtaining a large increase of revenue from this source, chiefly because incisive criti-

cism of company affairs is no longer characteristic of its editorial pages. From my own point of view, the 'Magazine' is not performing one of its proper functions; it is losing its independence, without which journalism of any kind is not worth the paper it consumes.

Meanwhile the 'Press' was going down-hill. Until 1910, even until 1911, the 'Press' did well, but from then it began to decline in its earning power. In 1913 it paid 5%; after that there were no further dividends



-the friends of Lord Harris
are offended!

until 1917. In the summer of 1914 I realized that things were in a bad way; suddenly the War broke out; I wanted to conduct the 'Magazine' until it was over and hoped that Edgar would go to San Francisco, but he had become associated with Hoover's splendid work in behalf of American refugees and then of the Belgians, so I realized that I would have to go to San Francisco if the 'Press' was to be saved. In the first days of February I went to New York to meet Mr. Bain, who had been in charge of both the editorial and business departments since the dismissal of Greene the year before. Our meeting was unproductive of any suggestion or plans for resuscitating the 'Press', so I returned to London to say goodbye to my friends and clean up odds and ends of private business. I made the round trip to New York from Liverpool on the 'Lusitania'; it was on the return voyage that the American flag was hoisted in order to gain protection from the German submarines. On March 6 I sailed again for New York, arriving in San Francisco on March 23, 1915.

The 'Mining Magazine' was a *succès d'estime*, but it was a rash journalistic adventure on my part, because it led me to give all my time to an investment that involved only one-sixteenth the money I had put into the 'Press'. It was good fun, however, and enriching as experience, particularly of men and mines in a world-wide way, for the mining finance of London had a geographic amplitude like that of no other city in the world. On leaving London I exchanged my common stock in the 'Magazine' for Edgar Rickard's shares in the 'M. & S. P.' He continued to manage the 'Magazine' for a couple of years longer, when he sold out to W. F. White. Mr. Bain succeeded me as editor, but he remained in London only a year, being followed by Edward Walker, the present

editor, who had been my most loyal and efficient assistant for six years. The one excellent feature of the 'Magazine' for which Mr. Walker was personally responsible was the 'Précis of Technology', a compendium of abstracts of technical articles in other papers and periodicals. This was much the best of its kind ever published. Mr. Walker did not merely give excerpts from an original article, he gave the gist of it conscientiously, writing it in long hand, and producing a peptonized version, rendered more easily digestible by references to other and previous writings on the same subject. It was genuine journalism of a rare sincerity.

On arrival in San Francisco in 1915 I found the 'Press' in a bad way. We were losing over \$1000 per month. Our subscription list, as a Cornishman would say, had 'gone scat'. It is unprofitable to cry over spilt milk, but it is wise to learn from mistakes. The business management became inefficient after Edgar Rickard went with me to London. Greene was a good advertising agent at Chicago but a poor executive in San Francisco; he was out of his depth. The editorial work was only fairly good; Bain was deservedly popular, but he lacked the critical faculty, without which no man can be an effective editor. He and DeKalb did not work well together. Moreover, the revolution in Mexico hurt the 'Press', because many of our advertisers did business there. One good thing was done just before my return; that was the appointment of Charles T. Hutchinson as business manager. The appointment ought not to have been made just before my arrival, and that almost queered it; but I decided to accept the situation, rather than cause further disorganization. Soon I found that a bit of real luck had come our way, for Mr. Hutchinson proved himself admirably fitted for his work from the start and I have every reason today to thank the fortuitous circumstances that brought us together on the staff of the paper. The evidence of loyalty and skill in the business chief was a source of much encouragement during the two trying years that followed. I had to carry the burden of the editorial work, which on my arrival was increased by printing four pages—instead of three or less—of editorial criticism and comment in each issue. I had been in touch with the issues of the War from its beginning, but as the United States was neutral, I could not, at first, write on the subject in the 'Press'. When, however, our country entered the conflict, I was permitted to speak out, and did so gladly. Some readers did not like it and cancelled their subscriptions; they were mostly of German origin. I could have given their names and addresses to the proper authorities. Instead, I forgot them. The articles on the great issues arising from the War helped our circulation. Then there was flotation. E. H. Nutter, of the Minerals Separation company, undertook to tell me not to publish a certain article, namely, the interview with Charles Butters, appearing in our issue of August 29, 1915. From that moment I determined to publish as much as I could on a metallurgical subject that I foresaw would be of the most timely importance to our readers. Within two years we published enough material to make two books on flotation, both of which

sold 'like hot cakes'. On January 1, 1915, we had 4318 subscribers of whom 27.55% were in arrears; on January 1, 1917, we had 6214 subscribers of whom 7.62% were in arrears; our effective circulation was doubled in two years. The War called for an intensive production of metals; this stimulated mining, and therefore increased the demand for a technical paper like the 'Press'. At the close of the War a controversy arose between our Western miners and the Government at Washington over compensation for loss caused by the sudden collapse of the market for the secondary minerals used in the manufacture of munitions. The mining of these minerals had been stimulated by the patriotic urgings of officials connected with the Geological Survey and the Bureau of Mines, as well as by the Secretary of the Interior. It had been stated publicly, by these officials, that there was a great need for particular minerals, such as chrome and manganese, and that the miners could depend upon finding a sale for their products. Our paper supported the reasonable claims of those who were entitled to compensation and I deputed Mr. DeKalb to go to Washington, where he remained four months, for the purpose of aiding other representatives of the mining community in placing the matter effectively before the committees in both houses of Congress. In the end a relief measure was enacted, and a commission is now engaged in adjudicating claims. The expenses of publication, particularly the cost of paper, postage, and printing, increased greatly during the War, and since, but our business has prospered. In July 1919 Mr. McGraw, representing the McGraw-Hill Publishing Co., now controlling the 'Journal', opened negotiations for purchasing the 'Press', and consolidating it with the 'Journal'. The negotiations ended in a pleasant game of golf. The 'Mining and Scientific Press' is 'going strong'; it has an identity and a character established by its 60 years of honest effort; on this auspicious anniversary I salute the motto that serves to symbolize the activities of our institution: "Science has no enemy save the ignorant."

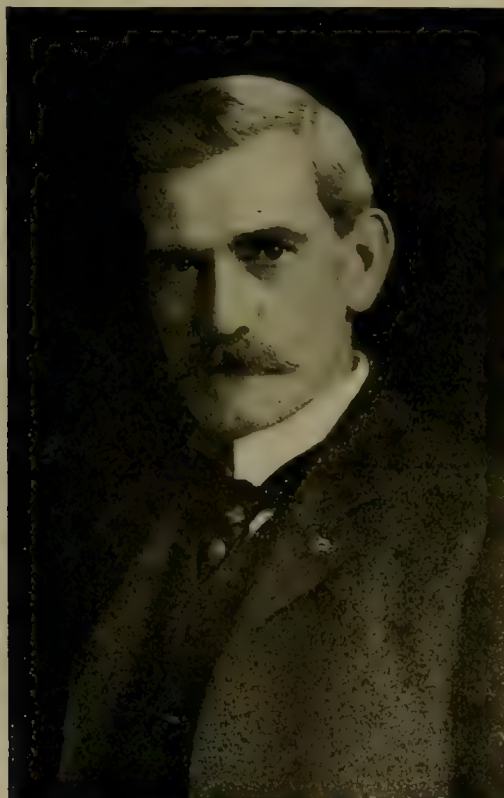
'TIN CANS' that used to be wasted to a large extent are now put to use. One plan is to recover the metallic tin. A patent granted to Daniel A. and Sidney H. Wilcox, of Garden City, New York, for a method of separating iron and tin is based upon the fractional distillation of their chlorides. The scrap to be treated is compressed and heated to a temperature bringing a vigorous reaction when chlorine is passed over the metal, both metals being volatilized as chlorides. The scrap may be melted and the chlorine passed through or over the melted metal contained in a bessemer converter, reverberatory, cupola or blast-furnace, electric melting-furnace, or muffle-furnace. By either method the mixed chlorides are separated by fractional condensation and the tin chloride may be converted into metallic tin or tin oxide. The ferric chloride is dissolved in water, reduced to ferrous chloride by passing the solution over hot iron, and electrolyzed, insoluble electrodes being used, so that the products are pure iron and chlorine gas, which may again be utilized.



ALMON D. HODGES, JR., Editor 1869-1871



CHARLES G. YALE, Editor 1871-1894



J. F. HALLORAN, Publisher 1894-1906



T. A. RICKARD, Editor 1906-1909; 1915 to date

Why Is The Mining and Scientific Press?

By CHARLES T. HUTCHINSON

Nothing short of the celebration of a sixtieth anniversary can explain or, perhaps one might say, condone, the injection of business within the sacred precincts of the editorial section of this paper. The editor is a kindly, tolerant gentleman, who is gentle and considerate to the business staff, but when it comes to space—well, "My dear sir, you may have all the space you like in the advertising section, provided, of course, it is duly paid for according to the statutes made and provided."

This, however, is a great occasion. "We", editorially speaking, are 60 years old, or young, as the case may be. Where are the editors of yesteryear? Gone, one after another, to the great beyond, where there are no labor-unions to strike, no paper-mills to squeeze out our life-blood with their enormous prices, no excess-profits tax, no postal-zone system of second-class rates, nothing but one 18-hole course after another with cherubs for caddies, balls from the starry firmament, and non-leakable fountain-pens. The business staff, alas! their mortality is higher than that of editors.

Who gets the business, pays the bills,
Finds the paper, cures all ills,
Writes the ads of smelters, mills?
The Business Staff.

George Fitch once said that an editor was a tired, nervous man, who spent all his nights trying to get things into a paper, and his days explaining how they happened to get in. With the business staff all is different. Their days are just one long sweet song, a continuous round of luxurious offices, good cigars, expensive luncheons at clubs and cafés, with the triumphant return about four in the afternoon with a sheaf of advertising contracts amputated from the bodies of manufacturers, accompanied by a smile on the face of the amputatee indicating that the operation was successful even if the patient sometimes dies of the shock. At least, this seems to be the popular misconception on the part of those who are on the outside, looking in.

How often have we (still the assumption of the royal and editorial prerogative) had otherwise intelligent gentlemen stop us on the street when we were hurrying with harassed expression to try and grab a few reams of paper before it was gobbled up by someone else, or to pacify some irate advertiser who objected to the mis-spelling of his name on the front cover, and say something like this, "Gee, what a snap you fellows have got. Nothing to do but sit around all day and collect the money that the world of advertisers insists upon forcing upon you. I wish that I had a job like yours at an enormous salary and nothing at all to do."

Nothing at all to do! Listen:

Why is the 'Mining and Scientific Press'? We hasten

to answer. Anyone can engage in the publishing business, or even publish a mining paper. All you need do is publish such interesting, useful, and instructive matter in such an attractive manner as to make every mining engineer, mine-manager, metallurgist, and chemist simply pass sleepless nights until he can subscribe. Then, when the subscription harvest has been garnered, convey, intimate, or permit news of this accomplishment to leak out in manufacturing and supply circles, and the faithful will simply fall over themselves to beseech and implore you to accept their advertising at empty-steen dollars per page. Then get a cash-register, select a repository for your funds, and employ a secretary who writes a good clear hand to prepare the dividend checks. Oh, yes. One thing more. It is perhaps advisable to provide a little ready money at the start, not too much, of course, say a beggarly million or so, because:

1. It has been known to be somewhat difficult to get the interesting, useful, and instructive matter right at the start.

2. It is also difficult to present it in such an attractive manner as to produce the desired result immediately.

3. It is even more difficult to convince the skeptical Missourianistic public that No. 1 and 2 have been successfully accomplished.

The publisher fills the function of one leg of a three-legged stool, or, since this is an engineering paper, is one angle of a delta-connected three-phase circuit by which mental energy is harnessed for the good of mankind. The other two legs, to revert to the homely simile, are the reader and the advertiser. Picture the toastmaster. "We have with us tonight," orates he, "Mr. Adiabatic Isothermal, who will enlighten us on the subject of his P. D. Q. type R. S. V. P. two-stage belt-driven air-compressors with horizontal intercooler, and plate-outlet valves to the extent of a double-page spread in the advertising section of the 'Mining and Scientific Press'." A toastmaster of less dignity might even say, "Meet Mr. Adiabatic Isothermal", or perhaps even "Shake hands with Ad. Iso.", and remark further, "He is a good scout, so treat him kind". Anyway, the effect is the same. The publisher is the toastmaster, the introducer, so to speak. He renders so valuable a service to the subscriber through the editorial section that said reader pays real honest-to-goodness money for the privilege of reading it; he renders an equally valuable service through the advertising section in bringing to his readers, however remotely they may be situated from the base of supply, the latest news of the development of apparatus and accessories needed by the reader for the conduct of his operations. The advertiser is served through the extension of his sales and the profit accruing therefrom. The

publisher also profits, at least he did before the advent of excess-profit taxes and postal-zone rates for publications, and that is where he comes in. Truly an ideal situation. Three parties, all benefiting from a mutual service rendered each to the others, and yet there are Marxian socialists, bolshevists, and other weird sorts of 'ists who would reform the world by eliminating all profits therefrom.

Perhaps you may conclude from the ending of the above paragraph that the lot of a publisher is one long round of beatific dreams of happy, contented readers, and equally happy and contented advertisers. Don't you believe it! Pause, before you decide to enter the publishing business, because here goes for some real 42-centimetre revelations.

In the first place, editors are born, then made, and the making is a long and tortuous process. There are no ready-made editors lurking coyly on the literary shelves waiting to be plucked from their hiding-place in response to Requisition No. 4-11-44 calling for 1/12 doz. asstd. technical editors as per specification herewith and hereby made a part of this agreement. In a paper such as the 'Mining and Scientific Press' you must first catch an engineer of mines, give him years of field experience blended with a predilection for contributing to the technical press and engineering society transactions, then whisk him into an editorial chair and teach him how to cultivate a nose for news, a facility for expression that will not only enable him to use words but say something when he does. Put all these things in a test-tube, bring the mixture to the temperature of fusion, and permit it to cool, then shake well before using. Shake it immediately after using if your subscription list shows a tendency to slump. Then repeat the process ad lib until, after sixty years or so, if your beggarly million holds out, you may have an editor.

Then comes the business staff. That is not simple, either. A good, used business manager, solicitor, or office man is better than a cheap new one. Don't trade in your last year's business staff for a this year's model, however alluring it may be with its shiny nickel, bright new varnish, and luxurious upholstery. Given a sprinkling of common sense, a general business training, an inexhaustible fund of patience, and back it all up with a sincere belief in the worthiness of its cause, a business staff may be recruited from the general rank and file of industry as a whole. With this to start with, all that is needed is time for the development of a real organization. The first hundred years is the hardest, of course. After that, comparatively plain sailing is assured. *Experientia docet*, which means that the business problems incidental to publishing are peculiarly their own, and involve most of the problems encountered in other occupations, plus some new ones, that nothing but concentration, study, and the old gospel of hard unremitting toil will solve.

Consider one angle, that of selling. The hardest job is that of subscription-getting. If cost were ignored it would be easy, and for that matter, so would everything else. The mechanical cost of publishing the 'Mining and Scientific Press' today, that is, paper, postage, printing,

composition, cuts for illustrations, binding, mailing, and wrapping is \$9 per year. The subscription price domestic is \$4 per year. Thus, each subscriber, so far as he individually is concerned, represents a direct monetary loss to the publisher of \$5. If, to pursue this line of thought further, the editorial, executive, and fixed charges are added, the cost becomes \$22 per subscription per year, and the monetary loss to the publisher on each is \$18. And, we may add, costs are getting higher daily. How can this be done? Answer: the advertiser pays the freight.

It is fairly obvious, therefore, that the obligation of the reader to the advertiser is quite as great as to the publisher. The price paid by the advertiser for space produces sufficient revenue to make up this loss, and, if all goes well, leave a crumb or two for the publisher himself. Here then is the selling angle. Each subscriber, considered by himself, represents a direct loss to the publisher, unless that subscriber is a possible—no, probable—purchaser of the apparatus and supplies advertised by the patron of the selling section of the paper. Advertising rates are theoretically based upon the number of buying units represented on the subscription list. Therefore, any subscriber who is not a buying unit means a direct monetary loss to the publisher and the advertiser alike, as mere numbers in a class paper is as useless as the padding of the legs of a grand-opera tenor, good-looking from the surface, perhaps, but a mere sham when exposed to the pitiless investigation of the skilful space-buyer.

The part played by the editorial staff is to prepare and present matter that will hold the interest of the buying units. The business staff must sell this to buying units, and to none other; it must do it at a cost as low as possible, and, when the world is the field, one test of the efficiency of the business staff lies in the cost of selling subscriptions. When it is considered that there are nearly 7000 subscription accounts on the books of the 'Mining and Scientific Press', that the highest amount is \$6 and the lowest \$4, the reader of this little article may amuse himself in calculating the time required to work out a collection system that will get the money for these multitudinous little bills at a cost of a few cents each.

The keystone in the arch, the base of the pyramid, the foundation upon which everything depends is the reader. He is first, and the other two, that is, the advertiser and the publisher, trail obediently after. A publication that has a generous quota of readers, not merely subscribers who are talked or cajoled into taking a paper in order to get rid of an importunate solicitor, who renew their subscriptions year in and year out because they genuinely profit thereby, is as much of an institution as the greatest industrial organization in the land. Any publication that holds the interest of its readers is the advertiser's best bet. An equal interest in the advertisements is automatically assured, for there is no double standard in an intelligently edited paper; the advertising section is as carefully scrutinized as that given over to editorial matter, insofar as is humanly possible; the reliability, honesty, and truthfulness of the advertisements are on a par with every other part of the paper.

Speaking of papers, who was the genius who first spoke of the editorial section as "reading" matter, as if the advertising section were not just as much "reading" matter, if not more so? How, forsooth, does Mr. Mine Manager in the Transvaal, for instance, know that there is such a thing as a new type of air-compressor that has a higher volumetric efficiency than the one he is using and promptly proceeds to buy one to the credit of his sound good sense and the profit of his stockholder? How does he know of an improved stoper, a better ball-mill, a more economical primary breaker, or a more efficient electrical generating set? The ads, that's all.

A mine is a hole in the ground with a—No, why repeat that old one! The first stage is the prospector. In his pack are a pick, a shovel, a pan, and a few sticks of 40% dynamite. Then comes a little hoist, a bucket, some wire-rope, and a car or two. Then with depth, a pump, and perhaps a boiler or gas-engine. Soon a small compressor arrives, with one or two one-man drills, an air-receiver, some drill-steel, and the inevitable belting. The enterprise grows. Candles are no longer adequate. Enter the little electric generator, some lamps, wiring, fittings, and a little toy switchboard. Behold, the prospector departs, and enter the engineer in his lace boots. A bunk-house, a cook-house, and an office go up. The lumber, cement, paint, and corrugated sheet-metal begin to arrive, and, closely following, the mill itself with its multiplicity of auxiliaries. The whole products of the industrial world are represented within its walls; the brain and brawn of thousands are employed in designing and manufacturing the enormous variety of apparatus required in winning the metals from their mother Earth.

How does one know what to buy, and where? Answer: read the ads, and they carefully do, with avidity. How can they help it? From its very inception every mining enterprise is inseparably connected with the advertising section of the technical press. The fund of knowledge of the competent mining engineer is drawn just as much from the advertising as from the editorial section; the two are the gold-dust twins that, hand in hand, lead toward success.

Another thought before the five o'clock whistle blows. Why should the advertiser generously pay so much for his space as to counteract the loss on subscriptions? Answer: what he pays is little, perhaps too little, in view of the value of the service to him. Take the 'Mining and Scientific Press', for example (really, it is the only paper, anyway). For a mere \$45 per week, an advertiser can set forth what he has for sale, and discuss its merits, before an audience of nearly 7000 potential buyers, and do it 52 times per year. The cost of postage alone on 7000 letters is \$140 first-class and \$70 third-class for domestic delivery alone. Sounds fair enough, doesn't it? And yet there is a genius back in Washington who wants to tax advertising as a 'conservation' measure.

Then again, take circular letters. Do you read them? Where may they be found after you have gone through your mail? The waste-basket. And when the 'Mining and Scientific Press' arrives it goes to your desk. When you have read it, it is passed around, frequently through

five or more hands. Perhaps it is clipped in places for your note-book, or it is filed away carefully for binding when the volume is complete. When you want to know who makes what, there is the Buyers' Guide and the Advertisers' Index at your elbow. You pay from \$4 to \$6 per year for this. The advertiser pays an amount depending upon how much space he uses. The publisher gets the remains after the bills are paid.

Everybody is kicking about the H. C. L. and rightly, but—do you realize that the only brake that keeps the H. from getting even H-er, and that, in the end will lick the everlasting stuffin' out of the H, and leave nothing but the C. L., is advertising? Class in elementary economics, stand up. Everybody who knows anything about costs knows that the one great essential cost, and consequently price, reducer is volume of sales. Prime cost is divided into three parts, labor, material, and overhead charges. An increased volume of sales reduces all three, and the last more than the other two. The executive and administrative expense for a Ford automobile, for instance, would be no greater in volume for 200,000 cars than for one. The same applies to every other manufactured article. Before the days of advertising, there were no great manufacturing industries. There were, instead, some odds and ends of jobbing shops, whose output, what there was of it, was limited in distribution to the extent of the transportation facilities of the times and the abilities of the salesmen to get around as best they could and interview personally such prospective buyers as they could reach. Imagine, in contrast, attempting to sell a million safety-razors a year through personal solicitation, and, worse yet, the cost of the safety-razor which had to carry such a selling expense.

In our own field, try and picture to yourself a manufacturer of ball-mills, trying to hire enough salesmen to cover the mining districts of the world and the consequent cost of that same ball-mill. It is the advertisements in the mining papers that do the introducing; again we have the toastmaster in the guise of the advertising section saying "Mr. Mine Manager, meet Mr. Ball-Mill, on page whatever it is in the 'Mining and Scientific Press'." Interested mine managers communicate with the manufacturer of Mr. Ball-Mill, and thus do they get together by the straight-line method, the shortest distance between two points.

The advertising section makes more sales, lower costs, and more profits to reader, advertiser, and to the toastmaster. Therefore, for all of our sakes, buy advertised goods, because:

1. You can thus reduce the cost of what you want not merely to yourself, but to everybody else.

2. You can be reasonably assured that any man who has such faith in himself and what he has for sale as to come boldly out in the open and publish before the world his sales message, is a man who can be relied upon to make good.

3. The advertisers in the 'Mining and Scientific Press' are the flower of the flock. We know this because we picked them ourselves.

Here endeth the lesson.



PROSPECTING IN MALAY STATES

Shall Americans Go Abroad To Mine?

By H. FOSTER BAIN

Anniversaries are times for retrospection, also perhaps for a glance ahead. They are like the high points on the trail where the traveler pauses to look back over the course he has come and then maybe a moment at the way yet to be traversed before the great divide is reached. Ten years ago it was my pleasant privilege, as the then editor of the 'Mining and Scientific Press', to review the progress of mining and metallurgy in the half-century since the 'Press' was founded. Today, no longer in the harness, I may congratulate the present editor and his staff on the secure position in the regard and esteem of the profession held by the 'Press' and on the excellent manner in which it has weathered the storms of the last five years particularly.

In 1910 peace was general throughout the world. The civil war in Mexico, which has distracted the people and almost ruined the country since, only began late in that year. In Europe the cry of wolf had come so often that no one seriously contemplated the world disaster that came so soon after. In America business was excellent. The big new copper producers were making records day by day in production and cost, and mining men were anticipating the finding of many more such deposits. Engineers were busy, and happy. Prices were good, and the demand for metals and ores was expanding. Speculation both in New York and London was active.

It is hardly my province to review in detail the history of the years between. Rather I would point to one of the

many contrasts. In 1910 American mining men, both engineers and capitalists, were thinking mainly of American development. There seemed still to be in the United States and its near neighboring countries an ample field for such energy and money as could be spared. Nationally America was still a debtor nation, which meant merely that opportunities were yet so common and so good that it paid to borrow money to invest in local enterprises. Now this has changed. While there is need for much money and labor for home enterprises, the relative position of domestic and foreign fields for investment has been reversed. So much has been said about the increase in America's gold reserve and the gain in liquid resources as compared with other countries, that it is not necessary to labor the point. It is enough to recall the fact that the stock of gold is a burden rather than an asset unless it be profitably employed. It represents something already given in exchange. If either it or the credit that may properly be built upon it lie idle, there is a continuing loss of interest which would soon eat up the profit of the transaction by which the gold was gained. If, on the other hand, the attempt be made by expansion of local credits to put into use in America all of the newly acquired wealth, the result would merely be to set American manufacturers, or operators in other industries, competing against each other for labor and supplies, which would raise costs, and also for markets, which would lower selling prices. In a short time the ad-

vantage of intensified production would have disappeared. Labor, capital, and demand for goods are all bound together by intimate ties and a sudden large expansion of one without corresponding increase in the others unbalances the system. Undoubtedly much money can still be used wisely in America, to improve the transportation system, to develop water-power, to open mines, and to increase plant, but to attempt to employ our whole resources at home, in view of the limited supply of labor, would bring economic disaster by building up costs without corresponding increase of output. American costs are already a handicap in certain directions.

If then we are not to employ our money at home, how is it to be invested? There have been many appeals recently for generous loans to Europe and certainly the need is great. It would nevertheless be a mistake, as Mr. Hepburn has pointed out, to make loans on sentiment. Sound business will be financed without doubt, but our friends abroad should realize that no permanent good can be accomplished by introducing ruin into American finance, and unsound loans would certainly do this. It is also to be remembered that Americans are not by habit a lending people. In 1918 when, apropos of the success of the various Liberty loans, so much was being said of the possible future bond-market in America, I remember discussing the matter with my very shrewd and sound friend, J. H. Mackenzie. Somewhat to my surprise at the moment he took the ground that it might not be an unmixed blessing to develop the saving and bond-buying business in America too generally. As he went on to say, among the reasons for the United States achieving its rapid industrial expansion was not only the wealth of resources but the spirit of the people, the willingness to take a chance which comes from working with your own money. It is characteristic that bankers, who employ other people's capital, cannot and do not make speculative investments. If America as a whole, through growth of the bond-buying habit, converts its private capital into public capital, it is bound to lose something of the venturesomeness that has helped to make the country great. I believe that Mr. Mackenzie is right and that just as the American soldier had to fight according to his own traditions in order to achieve victory, so our financing of foreign investments, to be sound and successful, must be along lines developed in our home enterprises.

Perhaps the greatest difference between American and European mine finance is the much smaller extent to which the former is dependent on public money. In the United States all the big mining groups are controlled by men who are heavy investors in enterprises they direct. In a number of cases the ownership is so closely held that the companies are public in little more than name. In nearly every instance the mine or company was made a success before the public was invited to participate, and the initial risk was run by men who were playing with their own money. This is not true to the same extent abroad. There it is not unusual for a large mining corporation to be managed by men who have little personal financial stake in the enterprise and the initial risk is often underwritten by use of the treasury funds of a

company itself financed out of public money and managed by men who have not themselves put much money into, though they at times manage to take considerable out of, the enterprise. The American system of control results at times in amateur management and rather ruthless disregard of minority shareholders, though I am glad to believe that this latter condition is rapidly disappearing. The foreign system opens the way to all the evils which flow from speculation with other men's money. That it has not oftener led to disaster has been due to the character of the men attracted to the business and the sound self-interest involved in giving good management.

Turning now to the foreign field for mining, it may be asked how this applies and what the opportunities are. Clearly it is not in accordance with American tradition that we should merely buy bonds or shares in enterprises controlled by others. If we put money in, we want not only interest on the money but a share in the profits of development, and, if I understand the American temper, we are willing to take a share in the risk. No mere interest-paying investment is likely to make strong appeal to Americans. It will be remembered that even in our home mining enterprises when public money was called in, it was necessary to offer shares or convertible bonds to secure it. In the past American mining men have contributed technical skill to make successful mines in many lands and have sold machinery to foreign operators. If they are also to furnish capital, clearly they will ask and may justly expect to receive control and a share in the profits over and above return of capital and interest. In other words, the time has come for American companies to go abroad and mine much more generally than they have done in the past, creditable as is the list of important mines in foreign lands of which Americans are either owners or part-owners. There is every reason for pride in the achievements of our people in both metal and non-metal mining. We have developed methods of business and of technology that are distinct contributions to the world's knowledge, and with capital to back our efforts we may fittingly go out to apply these in foreign lands as well as at home.

It is not my purpose here to catalogue specific opportunities abroad. If I am right in the analysis of the situation made above, it will be the business of the leading American mining groups, and such others as may develop, to spend the money necessary to find these opportunities just as in the past they have spent it freely at home, and, when they have made sure of the soundness of the enterprise or have brought it to a stage where the risks can be fairly stated, to invite in such others as may care to take the risk. I may, however, mention some of the difficulties that will have to be overcome, premising that difficulties are but incentives to effort if the reward in view be sufficient.

One of the marked effects of the War has been to revive and stimulate the nationalistic spirit in all countries. A great effort made unselfishly for international peace has resulted in awakening dormant jealousies and reviving national selfishness. We deplore this, but must recognize it in our own national attitude as well as that

of others. It may be argued that the new selfishness is necessary and intelligent. That may be true, but my interest is in the fact that it is here and is one of the factors that must be taken into account in making plans. When the crisis came, nation after nation found itself lacking in some materials essential to successful conduct of the War. This was as true of minerals as of other things. Our own experience with tin, tungsten, manganese, and chrome may be mentioned in illustration. In other lands, as in Australia, the government found itself embarrassed by foreign contracts which controlled the output of war minerals produced under its jurisdiction. This fact has, I believe, been over-exploited and Australia was, I think, fortunate in having had her deposits put into productive condition even though it had been done by foreign capital. The material was there and in usable

sents a temporary phase of opinion and not a permanent conviction. The world's war debt can only be wiped out by intensified production and this requires the fullest development of dormant resources that the widest co-operation can effect.

It is entirely right and proper that each government should keep in closer touch with development than in the past. It must be in position to control its full material resources whenever necessary for its people's good, but this need not require that they be brought into productive condition only by its own citizens. The copper produced by the Arizona Consolidated and the petroleum won by California Oilfields are certainly as much at the service of the American people as though those companies were owned in the United States rather than in Scotland and England; and the same would apply in reverse to Amer-



KALGOORLIE, WESTERN AUSTRALIA

form and as conditions had been in the past this would not have been so if reliance had been exclusively on local capital and technical knowledge. For the present, however, Australians look at matters somewhat differently and are maintaining what amounts to restrictions on the inflow of any foreign capital. However well one may understand the reasons which have led to the development of this spirit there and elsewhere, one can but deplore the growing disposition to put fences around each country and exclude alien brains, money, and energy, regardless of their origin.

Van. H. Manning in his recent address before the American Mining Congress pointed out that if this is to be adopted as the settled policy of the world the United States is probably as well prepared for the resulting competition as any, but, as one American who has lived in and is fond of other countries as well as his own, I prefer to hope that this new national exclusiveness repre-

sents a temporary phase of opinion and not a permanent conviction. Nevertheless so long as any country maintains the contrary attitude it will not be good business for American engineers or American companies to look for business within its borders. If the attitude is based on an economic fallacy, it will be corrected in time; if not, we have no business there anyway.

There is another set of conditions which interposes difficulties in many of the independent countries. Generally, if these have attractive undeveloped resources, they do not possess a surplus of capital. They have, however, either been so exploited in the past or have seen other weak nations so exploited, that they are suspicious of all foreigners, and, having passed through a period of loosely granting large concessions to promoters, are now in a reactionary period of extreme reluctance to grant even usual and necessary rights to non-citizens. Siam may be cited as a case in point. This kingdom has suc-

ceeded in maintaining its political independence and is now under an enlightened and modern monarch who is an absolute ruler. Among the heritages of the past is the system of extra-territoriality which enormously complicates the problems of the local government whenever a foreigner is allowed to go into the interior, since he takes his own law with him. Aside from that, it is an affront to the dignity of the nation. The Siamese government has, very properly, made up its mind to get rid of the system and has been pressing the various powers for treaty revision. The British, being close to the country, saw, some years since, the advantages of acceding to the request of the Siamese and gave up their extra-territorial rights in exchange for four provinces, the connecting of the Siamese with the British railways, the appointment of numerous advisers to the Siamese government, and other substantial political and commercial concessions. The Danish government, through the accident of friendship between the King of Denmark and the King of Siam, also gave up extra-territoriality. As a result British and Danish companies have most important advantages in operating in Siam. For example, no American can legally reside more than 50 miles from Bangkok, nor can he legally even go into the interior to look at a property without a special temporary passport, which can only be issued at Bangkok. In the past the Siamese government has not been strict in the enforcement of these regulations, but lately it has shown a disposition to tighten the reins, and the relation between this and the fact that the Senate has never even considered treaty revision, with Siam is not hard to see. It will be recalled that Japan only got rid of extra-territoriality by enforcing rigidly the rules against foreigners residing outside the treaty ports. No one probably supposes that the United States has any disposition to be less ready to accord Siam full rights of independence than Great Britain but the latter has acted, even if she did drive a fairly sharp bargain, while we have not. There is no body of informed opinion in America regarding the subject, such as is necessary to bring about any public action in a country which is ruled by public opinion. If there were no law against adultery it would probably require an organized campaign of education to get it put on the statute-books, and this is much more true where it comes to such matters as revision of treaties with small foreign countries with which our relations have so far been mainly those of courtesy. This is one of our handicaps, and if we as mining men expect the United States to play a larger part in world development, we must do our share in building up informed public opinion at home.

Still another difficulty to be met in foreign mining is the fact that in many countries the mining laws and regulations are based upon conditions of the past rather than the present. This is a condition not wholly unknown at home but to an even greater extent it is the general rule abroad. Conditions in the Federated Malay States may be fairly cited here, though there are others which would serve equally well. Tin mining in Malaya was developed by Chinese, who went out into the jungle and opened small placer deposits with simple appliances. There, as

in early gold mining in California, much of the metal was at one time won by hydraulicking, and there, as in California, this was in time curbed because of damage to rivers and farm-lands. As other industries, notably rubber-planting, developed in Malaya, more and more restrictions were placed on mining. These, with the new avenues opened for investment and speculation, have diverted capital until, despite the large areas of possible mining ground remaining unexplored, development has fallen behind and output is steadily decreasing. Meanwhile dredging has been begun with all the resultant demand for central power-stations and yet, so far as I can learn, no relaxation has been made of the old rules designed to give to each mining claim merely the water used on it; nor does there seem to be any adequate recognition of the fact that in modern mining large power-plants are quite as essential as large deposits. This lacuna is even more evident in the new Siamese mining code, which is based upon that of the Federated Malay States.

In Northern Rhodesia the mining regulations have all been framed on the supposition that companies will be floated in London and include provision for a certain portion of the common shares being given to the local government for the mining rights. The possibility of mining to get a supply of metal rather than to float shares is not adequately taken into account, unless there has been recent revision of the rules. In China half the shares must be owned by Chinese, which frequently means that the foreigner must assume all risk and lend his Chinese partners the money they 'invest'. In the Netherlands East Indies the government not only takes an active interest in making geological surveys and mining studies but also develops and operates mines so that the field for foreign capital is, at least at present, limited. In the Union of South Africa there is neither rule nor prejudice against foreign money but there is the competition of well-established houses to take into account. This is a large, but not insuperable, handicap for newcomers. The mining industry is taxed heavily but it is scientifically done and in important matters the government supports and protects the mining companies. Russia is, of course, off the map for the present, though anything is possible there before these lines reach the reader. What will be the policy of the various European powers that have taken mandatories over the fragments of the German and Turkish empires remains to be seen, but it will not be surprising if, faced with heavy debts at home, they adopt a narrow policy where it is economically possible.

While the need and the advantages all lie on the side of a larger employment of American capital and technical skill in mining abroad, it will be seen therefore that the field is one only to be entered with circumspection. It requires determination, persistence, and patient accumulation of knowledge. Lest it be thought that my review be too pessimistic I may repeat my declaration of belief that a way can be found even in the countries where conditions are now most discouraging, provided deposits suitable for 'wholesale' mining are present. Clearly it will not pay any American company to go abroad for anything less important.



A GROUP OF COPPER MINERS AT YUSPENSKY

The Spassky and Atbasar Copper Mines in Siberia—I

By J. MACKINTOSH BELL

INTRODUCTION. The sparsely inhabited region occupying the south-eastern portion of the Kirghiz steppes and lying between the headwaters of the Irtish river and the Syr Daria, in Siberia, is remarkable for the large number of deposits of copper. The most noteworthy of these deposits is that on which is located the Yuspensky mine and those at Djes Kazgan, commonly known as Atbasar. Both these are now the property of the Spassky Copper Mine, Ltd.

The settlement of Spassky is situated 500 miles south-east from Petropavlovsk, on the Trans-Siberian railway.

Here are the smelters for treating the ore from the Yuspensky mine, which is 80 miles farther south-west. The coal mines that provide the requisite fuel are at Karagandy, 25 miles north-west of Spassky. Djes Kazgan is 260 miles west of Yuspensky as indicated on the map.

It is generally supposed that former inhabitants of the steppes, now vaguely described as Kalmucks, carried out primitive mining and smelting operations at the Yuspensky mine. The Russians first began operations about 1847, the two original prospectors being known as Oushakoff and Zotoff. In 1850 these pioneers were joined by



A RUSSIAN WORKMAN

another Russian named Ryasanoff, who soon afterward assumed control of the property and worked it intermittently until 1883. From then until 1897 very little mining was done, although the pumps were kept going intermittently. From 1897 to 1904 Ryasanoff again operated the property. In the last year the Yuspensky mine, together with the smelter at Spassky and other properties, was bought by French and English capitalists and the Spassky Copper Mine company came into being, although several years elapsed before it operated under its own name.

In 1913, the Spassky company, which had already a substantial interest in the Atbasar company, took over the remainder of the shares of the latter concern.

The Spassky Copper Mine company was one of the most remarkable achievements of foreign operations in Russia, notwithstanding quite unusual difficulties attending transport, labor, and climate. The ore from Yuspensky was carried in small native carts drawn by bullocks or camels to Spassky and there smelted with coal brought on a narrow-gauge railway from Karagandy. The copper ingots from the smelter reached the railway at Petropavlovsk in carts or sleds, which on their return journey brought the supplies required at the mines and smelter from the outside world. In winter when blizzards of a fury scarcely known on the American prairie and accompanied by very low temperatures rage across the steppes, the number of drivers, camels, and oxen that perish testify to the difficulties of keeping open the long dreary trail, hundreds of miles in length between the isolated mining settlements and the railway.

The labor was largely Kirghiz. They are a docile people, but capable of being thoroughly unpleasant when roused through an offence against religious prejudice or through a feeling of injustice. The training of these people as miners or workers at the smelter, with the assistance of a far from efficient Russian staff, required a persistence and patience that even the mining engineer, accustomed to pioneer work in outlying districts, is rarely required to show.

Notwithstanding all these obstacles, however, the company prospered greatly from 1910 to 1914; but after the opening of war difficulties arose in connection with the transmission, from London, of the capital required for additional plant; the transportation from England of certain materials in connection therewith; and the mobilization of many of the trained staff for service in the Russian army.

When these difficulties, which were to be expected during the progress of a great war, had been in some measure overcome, matters received a further shock from the outbreak of the revolution. Committees of soldiers and labor deputies were formed at the mines as elsewhere and took practical charge of affairs. The staff, in order to preserve the property from damage, remained and was actually employed by this committee to give the necessary direction to operations. Matters, however, went from bad to worse until finally, notwithstanding the strenuous efforts of the management, the mines and works were nationalized in March 1918. The staff then withdrew,

being given a warm send-off by the employees who had turned Bolshevik. Following the counter-revolution of the Cossacks soon afterward, they returned and were cordially welcomed by the erstwhile Bolsheviks. Operations on a small scale were recommenced and continued until the fall of the Kolchak regime in western Siberia. Mines and works are now once more in the hands of the Bolsheviks.

REGIONAL GEOLOGY. The geology of the Kirghiz steppes shows large areas of monotonous uniformity diversified by others covered by rocks of a great variety of age and petrographic character. Apparently the oldest rocks of the region are quartzites and phyllites, at least some of which are considered to be Devonian. Associated with these are extensive areas of igneous rocks of considerable diversity—porphyries, porphyrites, serpentines—some of which are highly metamorphosed. It is thought that these represent a wide stratigraphic range, but until more ex-



tensive geological work has been done than has so far been possible, no definite relationships can be assigned. Certain of the igneous rocks may, indeed, be later than the earlier members of the great series of Permo-Carboniferous strata, which have a widespread distribution in this region.

Marine Tertiaries cover most of the great desert of western Turkestan, lying south of Djies Kazgan. These extend northward through the depression of Turgai into the northern plains of western Siberia, where they are overlain by fresh-water Tertiary beds and by Pleistocene river and lake deposits.

LOCAL TOPOGRAPHY. Although a distance of 80 miles in a north-east and south-west direction separates the smelter at Spassky from the mine at Yuspensky, there is practically no variation in the character of the topography, which conforms in great part to the character of the geologic structure. The salient features at both localities are the broad plains and the generally low and isolated ridges. From the plains flat-bottomed valleys diverge among the hills and from these valleys again

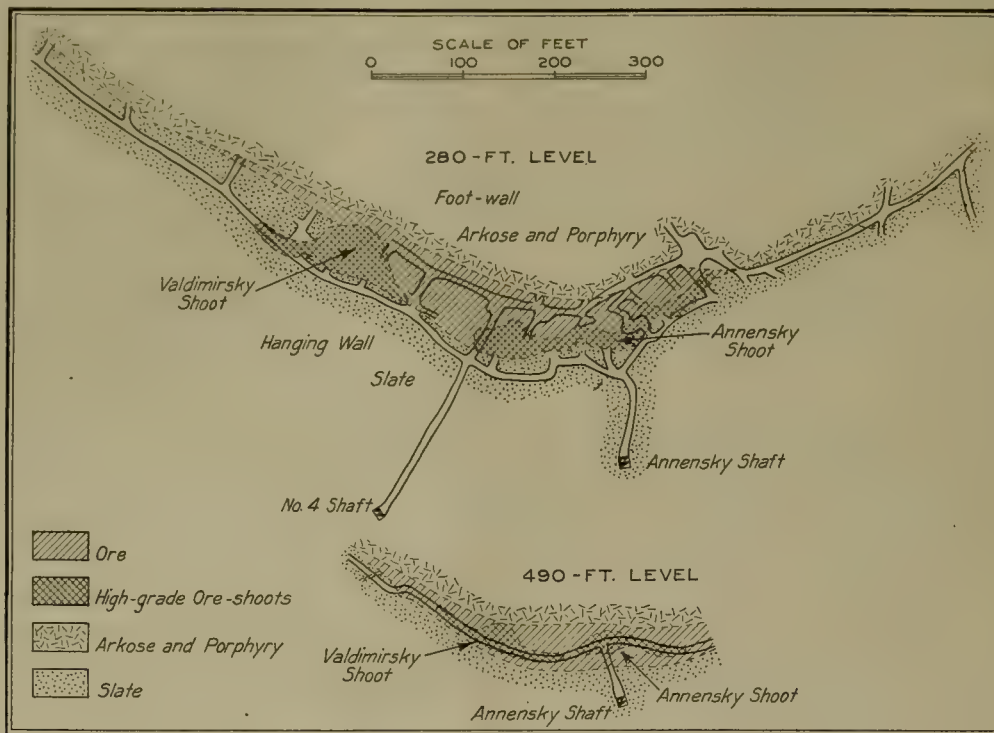
ravines ramify in every direction. Outcrops, often of peculiar and fantastic shape, characterize the crests of the hills and ridges, although in places the debris, so rapidly formed in a dry climate where the variation in temperature is extreme, shroud them to their summits.

The entire absence of trees gives the landscape a dreary aspect, despite the brilliant flora of early summer, which relieves for a time the gloomy picture.

Around Yuspensky the geology is complicated by pronounced a faulting, and by the shrouding of important structural contacts by debris. The sedimentary rocks exhibit two phases: a coarse phase, marked by conglomerate, arkose, and grit, none of which shows a definite stratification; and a finer-grained phase, of chert, slate, and lime-

features that need not be described here, lead to the belief that the sedimentaries followed closely after the extrusion of the volcanics and it seems probable that vulcanism may have continued while the sedimentaries were being laid down. The relationship of certain acidic phases of the igneous complex to the sedimentaries in the eastern part of the Yuspensky workings and on the surface above seems to suggest that the igneous rock is here intrusive into the sedimentaries.

THE YUSPENSKY ORE DEPOSIT has a general east and west strike, it bends to northward at both ends and is thus crescentic in form. Its inclination is generally southerly, although in places there is a northerly dip for short distances. It occupies a highly sheared and con-



SKETCH OF THE SPASSKY COPPER MINE

stone. The superposition of the latter over the former shows them in places to be slightly younger, although in general the two types seem to agree in age, the finer-grained rocks being deposited in deep water, whereas the coarser were being laid down close to the margin of an old land. The grits in places contain fossils, which are considered early Upper Carboniferous.

Associated with these sedimentaries are igneous rocks that are mainly volcanic but may be in part intrusive. The following types are represented: quartz-porphyry, oligoclase-porphyry, augite-porphyrine, and hornblende-porphyrine. Both massive and fragmental phases are exhibited, the former being the more conspicuous. There seems no reason to doubt, in view of the fact that the material forming the coarser sedimentaries is entirely derived from the igneous rocks, that the latter are in great part older than the sedimentaries. However, various

siderably faulted zone lying along or close to the contact of coarse-grained massive rocks with highly fissile stratified rocks. The former, the foot-wall country, consist both of igneous rocks and sedimentaries. The igneous rocks are mainly volcanics (older than the sedimentaries) but may be in part intrusive, younger than the volcanics and sedimentaries. The massive sedimentary rocks are fine conglomerates and arkoses. As the primary constituents of both phases of the foot-wall rocks are practically identical and are extremely altered they are often indistinguishable, even under the microscope. Both contain orthoclase, quartz, sericite, chlorite, and pyrite.

The hanging wall of the ore deposit is a slate younger than either of the foot-wall types. This slate is generally dark-gray, in places black and highly carbonaceous, or again calcareous. Adjoining the ore it is almost everywhere greatly shattered.

The deposit is a typical example of a copper-bearing lode, exhibiting in succession downward a zone of surface impoverishment, a zone of oxide enrichment, a zone of sulphide enrichment, and a zone of normal sulphide deposition. It is essentially a highly silicified zone of country containing much quartz and barite impregnated with copper minerals, the impregnation being greatest at or near the hanging wall and decreasing gradually outward into the barren foot-wall. Calcite, galena, and pyrite occur in the non-productive portions of the lode.

The original outcrop of the Yuspensky deposit is said to have been marked only by a few heaps of quartz and barite boulders, stained black, rusty, and green. Development commenced on an insignificant stringer of oxidized copper mineral that gradually improved in quantity and quality downward. Near the surface the copper content was relatively unimportant. At varying distances, but roughly at a horizon of about 200 ft. down, the oxidized ores were largely replaced by sulphides. As the early Russian operators had removed the oxidized ore prior to the mines being taken over by the present company, exact information as to the amount and richness of this ore is not available. However, it is said that exceedingly rich ore was mined beneath the 10 or 15 ft. of impoverished surficial material and above the water-level, which corresponds roughly with the top of the enriched sulphide zone. The poorer oxidized vein-material still visible shows malachite, azurite, cuprite, melaconite, and native copper.

The modern development and success of the mine is entirely due to the phenomenal richness of the ore in the zone of sulphide enrichment. This ore was cut about 200 ft. below the surface and reached maximum strength and richness between 325 and 450 ft. below. At greater depth both the quality and quantity diminished. At about 700 ft. the rich ore is reported to have been exhausted, giving place to the primary vein-filling.

Within the zone of sulphide enrichment there were two distinct ore-shoots, separated by low-grade stuff—the Annensky shoot to the east and the Vladimirsky to the west. The former had a length of over 300 ft. at the 350-ft. level and a width of 45 ft.; the Vladimirsky at the 280-ft. level had a length of 180 ft. and a width of 50 feet.

The copper minerals of these ore-shoots consisted almost entirely of bornite and chalcocite. Chalcocopyrite occurred only in minor amount on the upper levels, but increased in quantity downward. The richness of the ore, especially in the Annensky shoot, was, in places, phenomenal. Thus, between the 350 and 420-ft. levels, there was a well-defined band of almost pure chalcocite along the soft hanging wall so rich that when this part of the ore was being mined it had to be mixed with lower-grade ore for smelting, being richer than the matte desired in the metallurgical process.

These two ore-shoots were found where the enclosing rocks dip southerly, where the hanging wall of slate is highly shattered and where it contains a relatively high carbon content. It is noteworthy that barite was much more conspicuous in the richer ore than quartz or other gangue.

The magnitude of the lode itself is much greater than the shoots it encloses. At the 280-ft. level, for example, it has been proved for 600 ft. and for a maximum width of 70 ft. Other copper-bearing deposits in the same zone of dislocation may be found to represent the continuation of the one described.

As previously mentioned, the richest ore was along the hanging wall and merged outward through increasingly leaner ore into the barren foot-wall country. At Yuspensky no ore was considered high-grade unless it carried approximately 25%; none counted good unless carrying about 15%; while material with less than 8% of copper until recently was thought not worth mining. While the high-grade ore, within the two ore-shoots, has been mostly removed, much lower-grade material extends beyond the high-grade both on strike and dip and passes into the foot-wall. This poorer material is of a grade around 6% or 8% in copper. It seems absurd that this should be styled 'low-grade' ore, but the nature of the deposit and the remoteness of the locality serve to explain the use of the term. Exploration below the 700-ft. level as yet has been inconsiderable. It remains to be seen to what depth the ore of the zone of original deposition persists; the outlook is promising.

The Yuspensky ore contains small quantities of gold and silver, and generally some lead. A typical analysis of rich ore is as follows: copper 19.2%, ferric oxide 5.2%, lime 0.5%, sulphur 7.8%, barite 34.8%, silica 30.1%, and alumina 2%.

GENESIS OF THE ORE. The material of the Yuspensky lode was deposited in a zone of shearing, in which extensive faulting had taken place, by ascending solutions that apparently belonged to several generations and extended over a considerable period of time. Later changes in the lode, with the attendant shifting of the copper content, were made by descending solutions.

The first process apparently consisted merely in the silicification of the shear-zone close to the contact of the massive and fissile rocks. Shattering of the silicified zone ensued, this being due to renewed movement. In the open spaces thus formed rising solutions later deposited quartz, barite, bornite, and chalcocopyrite to a considerable extent and calcite, pyrite, and galena in minor amount; and at the same time impregnated the wall-rocks, replacing the slate, arkose, and porphyry. Further movement then took place, and it is possible that another deposition of copper-bearing minerals followed, although it is probable that the enriched sulphide zone is due mainly to descending solutions.

The ultimate source of the copper-bearing solutions is not known, but, judging by the widespread occurrence in the locality of small deposits of minerals of this metal associated with shear-zones in the porphyries and porphyrites, it seems probable that the concentration of copper has some connection with these rocks. As indicated in a previous paragraph, these rocks are at least generally older than the slates and arkoses forming the principal wall-rocks of the Yuspensky deposit, though not much more so, and it is possible that certain of them, difficult,

owing to petrological similarity, to differentiate from the main igneous mass, may be actually younger.

While part of the rich sulphide ore close to the hanging wall in the zone of sulphide enrichment may be due to a second generation of ascending solutions, it is thought that the principal portion of the copper of this zone was derived from the oxidation of the original copper-bearing minerals above, the copper derived therefrom being carried downward in solution as sulphate and deposited as sulphide below the water-level. Either original sulphide or the carbon content of the hanging wall was responsible for the precipitation.

METHODS OF MINING AND TREATMENT. The first mining was by an open-cut. Later the ore was brought to the surface through a number of small shafts worked with the simplest equipment. When the property was acquired by the present owners more systematic development began, but, owing to the remoteness of the locality, it has often been necessary to resort to devices and methods that would be considered primitive elsewhere. There are two principal shafts and a number of minor ones connecting the workings with the surface, levels being opened therefrom at intervals of 10 sagues (70 ft.), namely, at 280 ft., 350 ft., 420 ft., 490 ft., 560 ft., 630 ft., and 700 feet.

The principal difficulty encountered in sub-surface development has been in connection with the highly crushed hanging-wall slate. Drifts, winzes, raises, and cross-cuts in or near this wall required the strongest timber, which had to be brought many miles across the steppe, and needed frequent renewal. The mining method adopted was to extend a drift along the hanging-wall side of the vein, closely timbering it against the fissile slate; every precaution in blasting being taken not to shatter the latter. When this drift had been completed for the length of the orebody, and cross-cuts extended to the foot-wall at the desired intervals, a second slice of ore was removed immediately adjoining the drift, and so on, slice by slice, until the whole of the orebody at the level had been taken out. Waste was filled in after each successive slice, the quantity of timber as preliminary support diminishing toward the foot-wall. After the ore at the level had been all removed, the slice-and-fill system was continued upward.

The ore from Yuspensky was assembled in stock-piles at Spassky together with coal from Karagandy and limestone flux from the country adjoining Spassky. Smelting was at first done in small and primitive blast-furnaces, which required constant re-building, the materials of construction being mostly manufactured locally. When the present company commenced operations much reconstruction of these furnaces was necessary and in 1908 only one furnace was available, with a capacity of about 200 tons of copper monthly. In time new furnaces, still, however, on Russian lines and not water-jacketed, were constructed and the complement of converters correspondingly increased bringing the capacity of the plant in 1912 up to a little more than 400 tons monthly. The converters first erected were subsequently replaced by Pierce-Smith basic-lined kettles.

When it became apparent that the rich ore would soon be exhausted, a concentrating plant, using the Minerals Separation flotation process, was erected at Sara Su, to treat lower-grade ores and a reverberatory furnace was built at Spassky to smelt the concentrate therefrom.

Construction on both these units was delayed by the outbreak of war and neither was really effectively in use when the troubles attending the revolution began. The plant at Sara Su was destroyed by fire in July 1919.

STATISTICS. Some idea of the richness of the Yuspensky ore-shoots is gained from the value of the ore raised in the few years preceding the War. Thus, for the year ending September 30, 1909, 15,551 tons of ore was lifted containing an average of 16.6% copper; for the next twelve months 12,581 tons averaging 19.2%; and for the next 31,302 tons containing 15% copper. In the 15 months ending December 31, 1913, 43,591 tons of ore was raised averaging 22% copper, and in the year 1914, 20,697 tons with 20% copper.

The production of metallic copper since 1907 to the end of 1914 has been as follows:

For year ending	Tons
September 30, 1908	1322
" " 1909	1641
" " 1910	2384
" " 1911	2858
" " 1912	3998
December 31, 1913	*6251
" " 1914	4683

*15 months.

The cost of production has been exceedingly high compared with operations in other regions but it has been relatively low considering the remoteness of the locality, the several establishments, and the various other difficulties previously mentioned against which the company has had to contend. In the year ending September 30, 1908, the cost of production of a ton of copper is reported to have amounted to £41, but was actually more; for the year ending September 30, 1911, £37 14s.; and for the next 12 months £28 9s.—a relatively low figure, which seems approximately to have been maintained till the blast-furnaces were closed in December 1914.

Notwithstanding the high cost of production the company made handsome profits in the five years preceding 1915, being partly assisted in this regard by the higher price prevailing in Russia for copper (owing to the import duty) than elsewhere in Europe. Thus, in the year ending September 30, 1911, £77,000 was distributed in dividends, or 17½% on the capital, which then stood at £600,000; while in the following year dividends amounting to 25% on the capital were paid. In the 15 months ending December 31, 1913, the dividends amounted to rather more than 25% on the capital, and in 1914, when the capitalization had risen, owing to the inclusion of Atbasar, to £1,000,000 (with issued £1 shares amounting to £979,840) 10% was paid.

The ore-reserve at the end of 1915 is given as 429,475 tons, averaging 7.8% copper, which may be compared with 6100 tons of 20% ore in the mine, 21,083 tons of 20% ore in dumps, and 346,917 tons of 7% ore in the mine at the end of 1914.

The Prospector

By JACK MULHOLLAND

*The prospector is the man who is directly responsible for the large production of metals from the numerous mines which are in operation today. Most of the mines of the world have been found by the hardy pioneer; and only those who have been actually interested in this kind of work can realize to the full extent what hardships and privations must be endured if the prospector wishes to succeed. Take, for instance, the rough precipitous ranges of the Western States or the Province of British Columbia. Every pound of provisions and the necessary equipment, bedding, etc., must be carried on his back, though in many places it would seem impossible to be able to navigate without any burden; but those obstacles are overcome, and when night overtakes him, and lying on his bed of boughs before a roaring camp-fire with a good substantial pipe of tobacco, the prospector is generally the most contented and happiest man in the world. A few years ago there were a large number of these men roaming around in various districts, and, in fact, nearly all of our producing mines were found at that time. Although there are a large number of new shippers on our list, on investigating we find that they are old locations now being newly developed, thanks to the advanced price of metals and the great demand for them during the war period. A good many of the old class of prospectors have cashed in and crossed the divide, but there are still quite a few left, and the majority of those have quit and are seeking an easier means of getting their livelihood.

What provision has been made for the ones who have failed to find the so-called bonanza? A few years ago it was a common occurrence and an easy matter to find a business-man who would grubstake a prospector; yet today I doubt if you could find one in a thousand who would be willing to give back a small amount of what he has gained from this great developed industry. The Provincial government of British Columbia has decided to grant a large sum of money to aid the returned soldier and assist him financially to prospect. This may be the means of making a few more discoveries. Let us hope that it does. But it is funny that they never thought of spending a little of that money on the genuine prospector, the man who already had ten or fifteen years hard-earned experience and was forced to quit the game for lack of support. These same men are the country's greatest asset and should be helped, and the necessary means should be provided to keep them in the hills. If this were done it might create an incentive, or awake an interest in the generation growing up. It would at least be easier to induce them to get in and take hold and continue the work where the old-timer leaves off. The young men of today are just as good as the old pioneer was at their time of life, but the ambition for that kind of work has been killed, and the public in general is to blame for it. You

will find in every part of the country men who are old and feeble, poorly clad, and in many cases getting barely enough food to keep them alive. Those men are the ones who produced the great mineral wealth which you so often boast about, and of which you see an evidence here today—and yet, you wonder why the growing generation does not get in and follow in that same old-timer's footsteps. The life of a mine is limited, and to keep up the supply of metals to be able to fill the great demand, new mines must be found.

Another point which must not be lost sight of, and one which is vital, is the new discovery. There are only rare exceptions where the surface croppings are rich enough to allow the prospector to take out and ship enough to pay development expenses; and even in such a particular instance, there is no trail or means of transportation, therefore capital is needed. What invariably happens is this: the prospector being unable to obtain assistance, does the necessary work to fulfill the requirements of the law, and consequently the property lies practically idle for many years.

There are hundreds of this kind of group throughout the North-West, and with an expenditure of sometimes a small amount of money, a good many of those same prospects would become producing mines. What I consider one of the most essential needs of the present day is small development syndicates. This in my estimation is one of the greatest money-making schemes. For instance, options could be obtained on two or more promising prospects, for the purpose of developing them so that they would be considered in fit shape to turn over to the larger mining corporations, who are nearly always looking for a developed prospect. This would be a snap for business men who are well able to put up a few thousand dollars apiece; and by employing a good, practical, and competent man to handle and take charge of the work, the possibility of failures would be eliminated.

Prospecting in the developed or more settled regions is far more expensive for the present-day prospector. The higher altitude where the formation was practically exposed was examined in most places by the old-timer, who naturally looked for minerals in the places where they were easiest found. The lower altitude, which is generally covered by deep wash and heavy timber, has to be prospected by pick and shovel, which means time and labor and is very often disappointing. There are a good many ways and means of assisting and encouraging the prospector, and there should also be a free system of schooling through the winter months. Literature on practical mineralogy and geology should be published in a more simple form for the purpose of assisting the beginner. All the present literature, some of which is called 'prospector's handbooks', is utterly useless, unless the prospector should happen to be a college graduate. It always seemed to me that those books were written by professional men who knew but little on the subject, but by using such jaw-breaking and fictitious names they expected the general public to give them credit for being mining wizards.

*An address delivered before the International Mining Convention at Seattle on April 8.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

MUCH MANGANESE ORE BEING MINED AT LEADVILLE.

LEADVILLE.—With the disappearance of snow, mining activity, handicapped for fully four months, is reviving. Already half a dozen manganese producers are again on the shipping list and with the market re-opened a heavy tonnage will be mined and shipped this summer. Lessees are planning an active season in various sections, more especially on Carbonate, Fryer, and Iron hills; the Sugar Loaf, East Tennessee, and Iowa Gulch sections; and Canterbury hill.

Work is to be resumed shortly on the Emma and Marble placer on East Tennessee and the National Mining Co. is awaiting the opening of roads to get to work on Iowa Gulch properties secured from A. S. Sharp during the winter. In the Canterbury Hill section the Prospect Mountain Tunnel Co. will extend the tunnel projected to cross-cut the formation in territory heretofore unexplored. At present few of the larger companies are operating, but the Yak, Ibex, and Down Town mines are shipping steadily, while lessees are adding their quota to the district's production.

BRECKENRIDGE.—Rich lead-carbonate ore has been opened by Nels Ostrum and associates in the main tunnel of the Iron Mask on Schock hill. The Iron Mask company is extending a drift on the main vein at the 100-ft. level and is mining a good grade of ore. Detwiler brothers and Briback are sinking on the Price lode to open new stoping ground. The Foremost property on Chief mountain, that last year produced high-grade lead-silver ore, is again active with lessees operating. The Tonopah Placers Co. is operating a churn-drill ahead of its dredge, below Breckenridge; other boats have also started operation.

TELLURIDE.—Shipments of concentrates from the Tomboy and Smuggler Union mills for April were heavier than for several months, amounting to 130 cars, 70 from the Tomboy and 60 from Smuggler Union. The Liberty Bell mill resumed treatment the first of the week. New orebodies have been developed during the winter and a large tonnage of ore is reported available for milling.

CHAFFEE COUNTY.—The Colorado Silver Mines Co., owning a large acreage on Shavano mountain in the Chalk Creek mining district, near the town of Romley, plans construction of a concentrating plant. Test shipments, to the Ohio & Colorado smelter at Salida, of milling and sorted ores from the shoot in the Ada Bell vein, gave returns of \$12.13 per ton for mill grade and \$24.40

for sorted ore, based on silver at \$1 per ounce. One lot gave smelter returns of 50 oz. silver in addition to some gold, lead, and zinc. The property of the company is on the opposite slope of the mountain from the Mary Murphy mine, that has a production record exceeding \$25,000,000 and is still producing.

MICHIGAN

SHIPMENTS OF COPPER INCREASE.

HOUGHTON.—The first shipments of copper by boat left last week. The Calumet & Hecla has a considerable quantity awaiting shipment. While the output is now less than the shipments that are being made by rail, a considerable portion of the winter's accumulations still awaits transportation. Of the 32,000,000 lb. that the Calumet & Hecla company carried at the first of the year, more than 70% has been sold and contracted for. Much of the accumulation at the Hubbell dock is for foreign shipment and will go out within ten days. At Dollar Bay there is approximately 10,000,000 lb. Recent shipments are averaging six cars per day from the Hubbell plant, which now handles all of the production of the Calumet & Hecla and allied corporations. Indicative of the European demand for copper it may be stated that half a million pounds per day of the total shipments from the Lake Superior district is going to France and Belgium. This is being rushed to New York for trans-shipment instead of waiting for the cheaper and slower boat transportation.

In connection with the computations on the production of the Champion mine of the Copper Range group it must be remembered that, while there is a falling off in the output of 'rock', the mine never was sending so much mass copper to the smelter direct as at the present time. The average now is two cars per week of practically pure slab-copper; this does not show in the shipments of rock.

Tamarack shaft No. 5 of the Calumet & Hecla is bottomed at the 40th level. The shaft is used only for bailing purposes. It handles 9000 gallons in the large bailers that are used, so that 3,000,000 gallons per day is being taken out. Practically all the water is drained into this shaft. When the new underground haulage-way is completed it will be possible to re-open the Tamarack No. 5 for mining again, inasmuch as No. 12, South Hecla, will drain the whole district and the water will be handled by five electric pumps. When actual conglomerate-lode mining at No. 5 shaft was suspended the

openings all were in fair ground. This territory will be handled by sub-shafts. No. 3 Tamarack now is producing 9000 tons per month. There has been no sinking there for two years, but 23 drilling-machines are working. Work on the haulage tramway continues. Ultimately, when the present plan for hoisting the remaining conglomerate ore through the Red Jacket shaft is completed the whole line of shaft-houses at the Hecla, with the exception of No. 12, the supply shaft, and the shaft for the electric-wire service, will be taken down. The haulage connections holed to No. 6 and No. 7 three months ago. Additional electric power will be supplied from the new turbines ordered for the plant at Lake Linden. There will be two additional high-power turbines to replace the low-pressure equipment now in use. The latter will be kept for auxiliary purposes. It is hoped to have the new turbines ready for operation next fall. That will increase the electric capacity by 60,000 kw., according to plan.

NEVADA

NEW CONSOLIDATION AT GOLDFIELD.

GOLDFIELD.—The Atlanta, Merger, Blue Bull, C. O. D., and several other companies have passed into the control of H. G. McMahon and A. I. D'Arcy of the Goldfield Development Co. D'Arcy and McMahon have consolidated the companies under the name of the Goldfield Deep Mines Co., incorporated for \$750,000, or 15,000,000 shares of a par value of five cents. The company plans to prospect by drilling and then sink a 3000-ft. shaft to the granite in the eastern part of the district. Prospecting of the Consolidated vein in the granite has been proposed several times, but the expense can be met only by a combination of several assessable companies, using their treasuries jointly for the sinking of one shaft. D'Arcy and McMahon now control all but seven of the well-known Goldfield companies and the future of the district largely is in their hands. The Development again has reported that the mill is to be started, this time early in June. One hundred tons is to be treated daily. The returns from assessment No. 1 have been good, the delinquent list amounting to only 150,000 shares. It is estimated that the amount received will place in the treasury \$75,000, against which there is an indebtedness of \$36,000. It is reported that much of the ore on which the mill will be started will come from the Silver Pick, where there is a good tonnage of ideal material.

SILVERTON.—The new owners of the Tognoni group are erecting machinery to continue sinking the shaft from the present depth of 60 to 200 ft. and an effort is being made to finance the construction of a small mill. The finding of rich ore near the surface has led many lessees to start work. Engineers who have expressed poor opinions of other Nevada silver districts comment favorably on Silverton. Ore has been shipped at intervals since 1870, practically all coming from shallow shafts. The formation is limestone, greatly faulted, and intruded by rhyolite. There are three main veins and many cross-fissures, the vein in which the shaft is being sunk having

a width of more than 25 ft. For the last 30 ft. the shaft has been in ore, much of which is of high shipping grade.

TOKOP.—The Mt. Vernon Mining & Milling Co. plans to erect a small mill to treat 15,000 to 20,000 tons of \$15 gold-silver ore in claims bought from the Le Champ-D'Or French Mining Co. These claims have been worked at intervals since 1895, mainly by the French company. Shallow shafts have been sunk and a 500-ft. cross-cut tunnel, driven by the Le Champ-D'Or, reaches a depth of 150 ft. The Mt. Vernon for several months has been prospecting to find a shaft-site. The veins, four of which are exposed in the tunnel, are from a few inches to eight feet wide.

MINA.—The Minerals Separation engineers have reported to the Simon Silver-Lead company that the use of the Minerals Separation process will give an extraction from the sulphide ore of 93.9% of the silver, 93.7% of the lead, and 71.3% of the zinc. The silver-lead concentrate is valued at \$126 and the zinc at \$39, the former containing 76.1% of the silver saved and the latter the remaining 17.8%. The annual report of the Simon estimates the ore-reserves at 400,000 tons and states that "this ore is of such a grade as will return \$7.20 per ton net profit at the prevailing market prices for the contained minerals". P. A. Simon, president and general manager, says in the report: "It should be noted that our estimate takes into consideration the metallurgical treatment and losses, which are now definitely known." The report of the Minerals Separation is the first statement of the Simon Silver-Lead giving details of the result of tests on the ore.

UTAH

COL. WALL OPTIONS STOCK IN DALY MINING CO.

ALTA.—Excellent progress has been made in the unwatering of the Emma mine, and diamond-drilling has been started. Recently the showing on the 100-ft. level has improved. This ore, which a short time ago pinched down to one foot, has now widened to the full width of the face. Drilling from a four-foot hole on the right-hand side of the face assayed 15 oz. silver and 26% lead, according to George H. Dern, general manager.

PARK CITY.—Shipments of ore for the week ended May 8 totaled 2272 tons, as compared with 2803 tons for the previous week. The Judge M. & S. Co. shipped 629 tons; the Silver King Coalition, 723 tons; Ontario, 494 tons; Daly West, 296 tons; and Daly Mining, 52 tons. The Judge smelter shipped a carload of 33 tons of premium spelter during the week.

Announcement of the consummation of a mining transaction involving between \$300,000 and \$400,000 has been made by George W. Lambourne, general manager for the Judge Mining & Smelting Co. By an agreement recently made Mr. Lambourne has acquired an option on Col. E. A. Wall's interest in the Daly Mining Co., which amounts to between 90,000 and 100,000 of a total capitalization of 150,000 shares. The property of the Daly Mining Co. lies between the Ontario and the Daly-West mines, and has produced in excess of \$10,000,000 worth

of ore, with a dividend record of \$3,000,000. The future is considered promising, according to Mr. Lambourne, as there is a large virgin territory to prospect, in addition to ground already developed. The ore produced in the past has been silver-lead, with the silver content frequently running as high as 100 oz. per ton. The Daly Mining Co. also owns a half interest in the lower Ontario drain-tunnel and an interest in the upper Ontario drain-tunnel, in addition to a coal mine at Coalville, near here. Mr. Lambourne will leave within a few days for New York, where the financial details will be settled. It is more than likely that the option on Col. Wall's holdings in the Daly will be taken over by the Park-Utah Mining Co., development work in this latter property being carried on through the lower Ontario drain-tunnel. The physical condition of the Park-Utah is excellent, as ore has been opened up in four places and the lower tunnel is being put in shape for transportation of ore and supplies. When Col. Wall took over the Daly, some seven or eight years ago, it was believed at the time that the property was worked out. By patient work he brought the mine back to life and showed that there is still a large amount of undeveloped but promising ground.

EUREKA.—Ore shipments from the Tintic district for the week ending May 8 were the largest for many months, a total of 180 cars having been sent out, as compared with 124 for the previous week. The Chief Consolidated shipped 58 cars; Tintic Standard, 22; Dragon, 20; Eagle & Blue Bell, 15; Iron Blossom, 14; Colorado, 13; Grand Central, 8; Mammoth, 7; Victoria, 6; Centennial Eureka, 5; Iron King, 3; Gemini, 3; Bullion Beck, 2; Alaska 2; Sunbeam, 1; Swansea, 1.

The May Day drift, leading from the 1800-ft. level of the Yankee shaft, has entered favorable territory, according to George H. Dern, general manager. The drift is now 800 ft. from the shaft, and after cutting through a thin porphyry dike, recently broke into a fissure in a dolomite limestone formation. The main objective of this drift is another fissure about 300 or 400 ft. ahead, as it was in this latter fissure that the ore was originally followed from the 700 to the 1100-ft. level.

At the Plutus mine, adjoining the Chief Consolidated, the shaft has reached a depth of 1650 ft. The present plan is to sink to the water-level before prospecting, and from all indications it will probably be the middle of June

before this can be accomplished. Craig Sandusky is now superintendent of the property, having succeeded W. McClain, who has taken a lease on several properties in another part of the district.

A petition has been circulated among the members of the Salt Lake Mining Exchange asking the Board of Governors to appropriate \$250 to help defray the expense of compiling and publishing an up-to-date map of this district, to aid in a publicity campaign. It is expected that a decision will be forthcoming promptly.

The Chief Consolidated Mining Co. has just paid its 24th dividend in the amount of 10c. per share, or a total of \$88,423. The grand total of such disbursements to date is \$1,694,471. The Chief Consolidated has sold its build-



THE EUREKA-LILY MINE, IN THE TINTIC DISTRICT, UTAH

ings at Homansville, consisting of a large boarding house, compressor building, lodging houses, etc., to the Griggs Huish Leasing Co. The buildings are now being dismantled and will be re-erected in the vicinity of the compressor-building, lodging houses, etc., to the Griggs company.

BRITISH COLUMBIA

DIAMOND-DRILLING IN PORTLAND CANAL DISTRICT.

TRAIL.—To supply the new concentrator to be built here the Consolidated Mining & Smelting Co. of Canada is constructing a pumping-plant possessing some novel features. In order to be at the required distance from the water in the Columbia river at its lowest stage, and to avoid being flooded at high water, the plant is being housed in a waterproof, solid concrete chamber approached by a waterproof sloping tunnel also of concrete. The tunnel portal is well above high-water mark.

VICTORIA.—Charles Camsell, manager of the Vancouver office of the Canadian Geological Survey, has made the following tentative assignments for work during the coming season: Cariboo, D. A. Nicholls; Coquihalla, G. E. Cairnes; Eutsuk lake, R. W. Brock and F. S. Falconer; Frasa delta, W. A. Johnston and A. C. Shephard; Lardeau, M. F. Bancroft; Peace river, F. H. McLearn; Salmon river, S. J. Schofield; Taseko iron deposit, J. D. Mackenzie and C. H. Freeman; west coast of Vancouver Island, V. Dolmage.

The Tidewater Copper Co., at Sidney Inlet, Vancouver Island, has developed water-power on Indian creek and has re-started its concentrator at the Indian Chief mine. About 1000 tons of ore has been run through the mill, and the flotation process is said to be working smoothly.

PRINCE RUPERT.—The Granby Consolidated M. S. & P. Co. has effected the sale of \$2,500,000 worth of 8% bonds. This money is required to finance improvements that have been made at the Anyox smelter, including the by-product coke-ovens, and part of the equipment and development of the company's Cassidy colliery. It had been the intention to finance these improvements out of profits, but the unsatisfactory condition of the copper market and labor conditions prevented. P. Olesen has bonded a group of 16 claims from W. Hanna and Charles Flood at Hidden Creek, adjoining the Granby company's holdings. The consideration is stated to have been \$700,000. Boyle Brothers, of Spokane, have been given a contract for 12,000 ft. of diamond-drilling at the Big Missouri and another contract for drilling at the Premier mine. Lynch Brothers, of Seattle, have been given a contract for drilling at the Spider and Northern Light groups for the Anglunian Syndicate. The new compressor at the Spider has been put in place.

The last shipments of heavy machinery for the concentrator at the Premier mine have been delivered at the mine and the work of erection has been started under the superintendence of engineers from the A. S. & R. Co. The mill will have a capacity of 100 tons per day. Another shipment of about 300 tons has been taken from the mine to the wharf at Stewart, but the strike of the steamship-hands on the Grand Trunk Pacific boats will delay shipment to Tacoma. The steamship strike, too, is causing considerable inconvenience to mining men wishing to go to or come from Stewart, the town being temporarily cut off from communication.

HEDLEY.—A dispute between the employees and the management of the Hedley Gold Mining Co. regarding wages has been settled, the former receiving an increase of fifty cents per day. The minimum wage paid in the mine now is \$5 per day. G. P. Jones, the manager, states that it is not certain that the property will be able to operate at a profit under these conditions, but he was willing to give it a trial.

SLOCAN.—Metal mining in the district is tied up by a strike of the miners, who are demanding an increase of one dollar per day in wages. As a result one of the richest silver-producing camps of western Canada has become inactive for an indefinite period.

ONTARIO

SHORTAGE OF LABOR AT COBALT.

TORONTO.—The project for building a railway from Elk Lake to Gowganda will be carried out on a more extensive scale than originally proposed. The Canadian Light Railway Construction Co. has secured a charter from the Legislature, which only requires the formal assent of the Lieutenant Governor to become law. It has already an engineer and staff at work laying out the route to Gowganda and is ready to begin construction at once. In addition to serving Gowganda, a line will be built eastward from Swastika to Kirkland Lake, thence turning southward to Larder Lake and Skead Township and connecting with the Temiskaming & Northern Ontario line at Boston Creek. A westward extension into West Shining Tree and a branch to the Matachewan gold district may be undertaken later. The announcement has created great satisfaction in mining circles and will stimulate operations in localities that have been long retarded by a lack of transportation facilities.

KIRKLAND LAKE.—May 20 is the time officially set for the resumption of mining operations at the Tough-Oakes and the mill is expected to be running in the earlier part of July. Official announcement is also made that the merger of the Tough-Oakes and the Aladdin Cobalt has been completed and that the Burnside will be consolidated with these properties on May 10. The ore now in sight in the Tough-Oakes and Burnside mines is estimated at between 17,000 and 18,000 tons, which is stated to assay \$12 per ton. The Hunton-Kirkland is to be reopened immediately, the capital necessary to finance extensive development having been secured. H. McPorteous, former manager of the Vipond-North Thompson, has been appointed manager. Arrangements are being made to secure power from the Northern Ontario Light & Power Company.

PORT ARTHUR.—D. C. Peacock, of Duluth, and J. D. Lamont, of Virginia, mining engineers, are making a survey of the old Silver Islet mine 30 miles from Port Arthur with a view to reopening it. The Silver Islet, which was in operation 50 years ago, was a notable producer yielding about \$3,000,000 of silver, but was abandoned owing to flooding by the waters of Lake Superior. The estimated cost of pumping out the mine is \$50,000, but it is thought that a modern hydraulic equipment will overcome all difficulties from water. The shaft is 1200 ft. deep and hundreds of tons of rich ore were in sight when the mine closed down.

COBALT.—The tendency to hoard silver against declining quotations continued during the first ten days of May, and the consensus of opinion, despite the slump, appears to be that higher prices will again be realized. The Nipissing Mining Co., Canada's largest silver producer, has not shipped bullion for several weeks, although production is being maintained at an average of about \$375,000 monthly, or more than \$1,500,000 for the first four months of the year.

THE MINING SUMMARY



ARIZONA

Jerome.—The United Verde Extension company, in development work during the past few months, has entered the orebody on the 1500-ft. level and has run about 560 ft. of cross-cuts and drifts. The ore on the lower level has not come up to the tenor of that on those above, averaging but 5%. The management, however, does not regard this as discouraging, although somewhat disappointing. The orebody has not yet been entered on the 1600-ft. level, but this

Mining Co. will be made before Judge Deltrich in the United States district court at Coeur d'Alene on May 31, when the Federal company will renew its application for an order permitting it to make a raise from the underground workings of the Hecla to the surface as a means of establishing its apex contention. This hearing was to have been held recently at Moscow, where the Federal Court was in session, but by stipulation between the attorneys, A. H. Featherstone for the Federal company and John P. Gray for the



DREDGING IN THE YUKON

should take place soon. Verde Extension had on hand at the first of April 23,857,634 lb. of copper. It will increase output soon but not to full capacity.

COLORADO

Mayday.—W. A. Becker, who is having a cross-cut driven at the Little La Plata, intends to start sinking in one of the old tunnels on the Little La Plata where some good ore was mined a number of years ago.—Moigg & Curtet, lessees on the Southern Boy, expect to cut the vein with any round now. They are running a cross-cut to get under a rich ore-shoot in a shaft.—The Jumbo Mining Co. has started a force of men to work in the Cunningham tunnel, which, it is said, they will extend 500 ft.—Paul Dalpra, who has been leasing on a block of the Jumbo, will start shipping as soon as the railroad spur is opened to Mayday.

IDAHO

Coeur d'Alene.—Another move in the apex litigation between the Federal Mining & Smelting Co. and the Hecla

company, it was transferred to Coeur d'Alene on the date stated. Last April Judge Deltrich denied a similar application, but he has granted a further hearing.

MISSOURI

Joplin.—The Louisiana Mining Co. is developing what promises to be a good mine on the Rensenhouser land on the south side of Shoal creek, several miles south-west of Joplin, near the Fillmore bridge. The company has been opening the ground for some time, running three drifts from the mill-shaft. The 150-ton mill on the property is being operated part time, most of the work being devoted to underground development.

MONTANA

Butte.—As a result of a meeting of the I. W. W. miners' union, the recent strike has officially ended. All members were urged to "strike on the job". Simultaneously with this order, the following notice was posted at all of the mines: "No member of the I. W. W. will be employed at this prop-

erty." This action is an attempt to completely expel the radical element from the Butte district. This order will be enforced even at the expense of stopping operations. The High Ore and Mountain Con. mines have already been shut-down. Other A. C. M. properties no doubt will follow suit. —During the month of April, 26,000 tons of ore was milled at the Butte & Superior concentrator. Six thousand tons of concentrate yielded 6,300,000 lb. of zinc and 113,000 oz. of silver.

Whitehall.—The Jefferson Mines Co. is operating the Lamplight claim. A 40-ft. winze sunk in the prospecting tunnel cut ore assaying \$32 per ton in gold, silver, and copper. This vein is believed to be an extension of the ore-body developed in the adjoining Dorothy property. Cross-cuts have been driven from the bottom of the winze, and drifting to the north will continue for a distance of 50 ft. H. G. Klenze is principal owner of the property.

NEVADA

Carson City.—Ore panning free gold has been entered in the shaft sunk at the Southwest Comstock Extension, in the North Carson section of the Comstock Silver Belt. The shoot is said to have widened to three feet with the shaft apparently entering an orebody. Thurman G. Roberts is manager. The erection of a head-frame is proceeding at the property of the Nevada Protective Mining & Investment Co. and sinking of the shaft with power-drills will start about May 30. The shaft is 70 ft. deep and will be sunk at least 400 ft. Equipment includes a hoist and compressor. E. R. Argersinger is manager.

Golconda.—Rich silver ore has been uncovered one mile north of the Pinson ranch, close to the Southern Pacific and Western Pacific railroads. The strike was made by George Blaine and S. B. Kasper of Golconda and a strong vein is said to be exposed.

Manhattan.—The drift from the 800-ft. level of the White Caps has advanced on the vein 210 ft. The vein is 22 ft. wide and is said to average \$25 in gold per ton. The Black Mammoth Co. has purchased a 50-hp. electric hoist and a two-drill compressor. Sinking is to be resumed as soon as machinery is in place.

Winnemucca.—The Nevada Harmony Co. is erecting a hoist, compressor, and pump preliminary to sending the 100-ft. shaft 200 ft. deeper. A station will be cut on the 300-ft. level and drifting started. Ore of fair grade is being developed at the 100-ft. point. G. P. Williams is superintendent.

BRITISH COLUMBIA

An offer of settlement was made on May 12 by the Dolly Varden Mines Co., of Chicago, to the Taylor Mining Co., which the latter accepted. The Dolly Varden company has withdrawn all legal proceedings, together with the last petition for disallowance of the second legislative Act bearing upon the controversy, so that the Taylor Mining Co. is now in undisputed possession of, and with a statutory title to, the Dolly Varden property.

Victoria.—Through agreement finally reached with the Dominion and provincial governments in Canada the Granby Consolidated Copper Mining, Smelting & Power Co. has paid during the past few months close to \$1,000,000 in back taxes.

YUKON TERRITORY

Dawson.—The ice has broken in the Yukon and the entire river will soon be open for navigation. A considerable influx of miners and prospectors is expected to the Mayo Silver camp. Spring operations already are under way in the Klondyke. The thawing of the dredges is under way and before the end of May it is expected that much hydraulic work will also be started.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Thomas J. Jones is on his way from California to London.
J. R. Finlay has moved his office to 170 Broadway, New York.

J. O. Greenan is at Spokane, expecting to go shortly to China.

Wilton Shellshear is with the Miami Copper Co. at Miami, Arizona.

W. W. Taylor has returned from Korea and is now in San Francisco.

Stanly A. Easton is going to Chicago as a Wood delegate from Idaho.

George Wingfield is a delegate from Nevada to the Republican convention.

C. W. Whitley, vice-president of the A. S. & R. Co., has returned to New York.

William Dempster, mining engineer of Glasgow, Scotland, is in Utah on professional business.

E. E. Carpenter is general superintendent for the Candelaria Mines Co., at Candelaria, Nevada.

Bruce Marquard, mill-superintendent for the Sunnyside company, at Eureka, Colorado, is at Berkeley.

Morton Webber was in Salt Lake City recently, after a trip to New York. He is now at Mackay, Idaho.

A. I. Findley, editor of 'The Iron Age', New York, attended the Foreign Trade Convention in San Francisco.

Ralph S. G. Stokes is now assistant to the general manager of the De Beers Consolidated, at Kimberley, South Africa.

Frank A. Crampton and **Theodore H. M. Crampton** have re-opened their office at 1247 Ocean avenue, Santa Monica, California.

R. E. H. Pomeroy, superintendent of the Nevada Con. Copper Co.'s smelter at McGill, was in Salt Lake for a few days recently.

Lester E. Grant, assistant general manager for the Braden Copper Co., at Rancagua, has left Chile for Denver, Colorado, on vacation.

O. F. Brinton, general manager for the Western Utah Copper Co., has returned to his headquarters at Salt Lake City after a visit to New York.

E. H. Wolff, of the Illinois Zinc Co., at Peru, Illinois, was elected president of the American Zinc Institute, at its convention held in Chicago on May 11.

The Nevada section of the A. I. M. & M. E. will hold its annual meeting at Tonopah on June 25 and 26. **John L. Dynan** is chairman of the local committee.

W. V. De Camp has resigned as field engineer for the Consolidated Arizona Smelting Co. to take charge of underground mining operations for the United Verde Copper Co., at Jerome, Arizona.

D. A. Lyon, supervisor of experiment stations for the U. S. Bureau of Mines, and **Thomas Varley**, metallurgist at the Salt Lake City station, conferred with officials of the station at Berkeley last week.

Charles Hayden, president of the Alaska Gold Mines Co. and vice-president of the Utah Copper, Chino Copper, Ray Con. Copper, Nevada Con. Copper, and Butte & Superior companies, is at Salt Lake City. He will visit San Francisco before returning to New York.

N. Nambu, mechanical engineer for the Sumitomo Besshi Copper Co., Japan, and **S. Yoshida**, superintendent of the electrical engineering department, have been visiting various mining camps in the United States. They will sail from Seattle on May 27 for Yokohama.

THE METAL MARKET



METAL PRICES

San Francisco, May 18

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10.50
Copper, electrolytic, cents per pound.....	19.25
Lead, pig, cents per pound.....	8.75-9.75
Platinum, pure, per ounce.....	\$85
Platinum, 10% Iridium, per ounce.....	\$130
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	10
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

May 17—Copper is quiet and steady. Lead is inactive but firm. Zinc is sluggish but easy.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending
Jan. 11.....	103.00	59.75	Apr. 5.....128.50
" 12.....	102.00	58.75	" 12.....123.75
" 13.....	100.00	58.12	" 19.....118.12
" 14.....	100.75	58.00	" 26.....117.87
" 15.....	100.75	58.50	May 3.....112.08
" 16 Sunday.....			" 10.....105.50
" 17.....	100.75	58.37	" 17.....101.21

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10
May	99.50	107.23		Nov.	101.12	127.57
June	99.50	110.50		Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
May 11.....	19.00
" 12.....	19.00
" 13.....	19.00
" 14.....	19.00
" 15.....	19.00
" 16 Sunday.....	
" 17.....	19.00

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66
May	23.50	15.91		Nov.	26.00	20.45
June	23.50	17.53		Dec.	26.00	18.55

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
May 11.....	8.50
" 12.....	8.50
" 13.....	8.50
" 14.....	8.50
" 15.....	8.50
" 16 Sunday.....	
" 17.....	8.50

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	6.85	5.60	8.85	July	8.03	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40
May	6.88	5.04		Nov.	8.05	6.76
June	7.59	5.32		Dec.	6.90	7.12

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920	1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82
May	100.01	72.50		Nov.	73.67	54.17
June	91.00	71.83		Dec.	71.52	54.94

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
May 11.....	8.15
" 12.....	8.15
" 13.....	8.15
" 14.....	8.10
" 15.....	8.05
" 16 Sunday.....	
" 17.....	8.05

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82
May	7.92	6.43		Nov.	8.75	8.12
June	7.92	6.91		Dec.	8.49	8.69

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	1918	1919	1920
May 4.....	100.00		97.00
Apr. 20.....	100.00		85.00
" 27.....	97.00		85.00

Monthly averages

Date	1918	1919	1920	1918	1919	1920
Jan.	128.08	103.75	89.00	July	120.00	100.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00
May	110.00	84.80		Nov.	120.00	78.00
June	112.00	94.40		Dec.	115.00	95.00

LIBERTY BONDS

According to the 'Boston News Bureau', one of the main results of the cheese-paring policy adopted in our war financing was expressed by F. A. Vanderlip as the creation of about 20,000,000 disgusted investors in the national war bonds. That distrust is the direct offspring of the severe depreciation that their investment has suffered. Perhaps some of this cause and of this effect was inevitable; but the extent, as resulting from an unduly low borrowing rate based on an artificially low credit basis arbitrarily controlled, is larger than financial statesmanship would have permitted. At least this is clear in the retrospect, and in the consequence. Concretely, the latter is a discount of over two billion—or a trifle more than 10%—on the world's premier security.

Thus, of the \$21,431,527,368 Liberty bonds and Victory notes originally issued there were outstanding on April 30, \$19,975,387,113. Continuous selling pressure has resulted in a discount in the selling price of the bonds of \$2,165,092,719, or 10.8%. There were outstanding of the first Liberty loan and converted issues on April 30 a total of \$1,952,905,730. If the proportion of converted issues of this loan has held relatively the same as on December 31, 1919, the 3½% bonds comprise about 72%, the First 4s 6%, the First 4½s 21%, and the Second converted 4½s 1% of the total loan. Taking the discount at which these several issues are now selling, the total for the First loan shows a reduction from the face value of the bonds of \$178,639,033.

The Second loan outstanding at \$3,393,620,050 consists of the Second 4½s, which account for 83% of the total, the remainder being the Second 4s. At the current discount the depreciation from the issue price is \$473,258,433. The Third and Fourth loans contain but one issue each, the Third 4½s and the Fourth 4½s respectively. The depreciation for the Third loan is \$405,860,247 and for the Fourth loan \$931,519,930. Of the \$4,404,861,650 Victory notes 79% are 4½s, and 21% are 3½s. The respective discounts are \$138,814,239 and \$37,000,837.

Somewhere around 20,000,000 different individuals and companies were subscribers to war loans. These bond purchasers have sustained, at present market prices, a loss averaging \$108 per subscriber—the result of selling the bonds on an artificial money market sustained by the Federal Reserve Board at a lower rate than natural conditions warranted. Allocating the loss to our entire population it is found to be \$19 per capita.

It is true that, as citizens, the investors in war bonds share in an indirect double profit that Uncle Sam makes—in his paying less aggregate annual interest than he otherwise would, and in his redemption of a considerable part of these obligations well below par. The Treasury, through the sinking fund, has bought back, at an increasing discount, \$1,456,000,000 of war bonds to date, bringing the outstanding total to just under 20 billions. This means a saving also in annual interest of almost \$58,500,000, or more than a million a week.

But that is cold consolation for the individual bondholder, confronted with his own specific loss in principal, and either handicapped in ability or puzzled in judgment—in view of a floating debt of nearly three billions and the chance it will be increased perhaps 50% further by bonus legislation—as to whether the time has come to try to 'average' such losses.

MONEY AND EXCHANGE

Foreign quotations on May 18 are as follows:

Sterling, dollars:	Cable	3.84½
	Demand	3.83½
Francs, cents:	Cable	7.04
	Demand	7.02
Lire, cents:	Cable	4.97
	Demand	2.17
Marks, cents		

Eastern Metal Market

New York, May 12.

All the markets except that of tin are inactive. They are all more or less depressed as an after effect of the railroad strikes.

Demand for copper from domestic consumers is light. Prices are a 'shade' easier.

Buying of future tin by dealers has been heavy. Prices are much lower.

There has been a decided reduction in lead prices and buying is only fair.

The zinc market continues lifeless with quotations nominally a little lower.

Antimony is dull and lower.

IRON AND STEEL

Seldom, if ever, have iron and steel consumers suffered so generally from a lack of material as at the present time, says 'The Iron Age'. That steel-plant and foundry operations are heavily curtailed or shut off altogether without loud cries of complaint, is explained by a realization that mills are not to blame for the railroad strike and that if manufactures cannot be shipped it is not surprising that raw materials are not received.

It is estimated that 1,000,000 tons of finished steel is standing, loaded on cars and stored in works and mill-yards. In Chicago the Steel Corporation has now 21 furnaces active out of 29 and its operations are at a rate of fully 80% of ingot-capacity. The leading independent there has maintained operation at 70%. Fuel scarcity has been a major factor. One Eastern plate-mill has lately been unable to get more than 50% of its normal production. A sale of 1000 tons of foundry iron to Germany, the first for years, has been made.

The statistics of ingot production for April indicate a total for the country of 3,139,710 tons, or 120,760 tons per day, which is a reduction of about one-sixth from the March output of 145,000 tons daily. In the four months of this year the country has apparently produced 14,000,000 tons.

COPPER

Prices of leading producers have undergone a slight revision but the market is statistically strong. Electrolytic or Lake copper is quoted by leading interests as 19 to 19.25c., New York, for early delivery, but demand is light. There still exists an outside market where prices range around 18.75c., New York. It is a fact that stocks have been decidedly lessened lately because of labor troubles and that production has been considerably curtailed for the same reason. The trade position of the market is, however, excellent, so far as the future is concerned, if present conditions become better and no labor troubles develop. Buying for foreign account continues relatively of fair proportions. As a result of the financial arrangements to facilitate purchases by France it is estimated that that country will take about 8000 net tons per month.

TIN

A fairly heavy business has been done the past week, largely with dealers as buyers. It has been for future-shipment metal, principally, and amounted to over 1100 tons. The transactions took place mostly on the New York Metal Exchange. On Wednesday, May 5, it is estimated that 300 tons was bought; on the next day 100, and on the next 425 tons. On Monday this week, at least 225 tons was involved. The report that as high as 2000 tons changed hands on Thursday, May 6, is not credited. The price range was from 58c. on May 5 to 55c. on May 10. This movement was brought about by a decided speculative decline in the Lon-

don market last week. Consumers of tin have not been interested, however, and there is no doubt but that tin consumption has been exceedingly curtailed, some mills being closed down. While most consumers are pessimistic, they have begun to show more interest. Spot Straits tin, New York, has ranged in the last week from 58c. on May 5 to 55.50c., New York, on May 10. Yesterday it was 56.25c., New York, while in London it was £312 per ton. Arrivals thus far this month have been 2260 tons with the quantity afloat reported at 4270 tons.

LEAD

There continues to be a moderate inquiry for prompt lead. However, those who possess it are either holding it or parting with it only in small lots. The values range around 8.75 to 9c., New York, were there any to sell for this delivery. The American Smelting & Refining Co. late on Friday reduced its price $\frac{1}{2}$ c. per lb. to 9.25c., St. Louis, or 8.50c., New York. Various reasons are given for this step. One is that the London market broke late last week so as to permit of imports of lead to a figure that would include the duty and cut the leading interest's price of 9.75c., New York. The outside market was already at 8.75c., New York. Some business was transacted as a result. Another reason advanced is that since the metal can now be moved on contract with great difficulty, the price has lowered so as to buy ores advantageously. The two reasons are given for what they are worth. The quotation today for early delivery is 8.25c., St. Louis, or 8.50c., New York, with demand light.

ANTIMONY

The market is quiet and lower at 10c., New York, duty paid, for the higher grade with the lower grades around 9.50 to 9.75c., New York, both in wholesale lots, for early delivery.

ALUMINUM

Quotations for wholesale lots of virgin metal for early delivery are unchanged at 33c., New York, from the leading producer and at 31.50c. from other sellers.

ORES

Tungsten: Business is flat and quotations are nominal at \$7 per unit for Chinese ore. Higher grades are valued up to \$15 per unit.

Ferro-tungsten is quoted at 85c. to \$1.15 per lb. of contained tungsten.

Molybdenum: Quotations are nominal and unchanged at 75c. per lb. of MoS_2 in regular concentrate. There is no demand.

Manganese: High-grade foreign ore has sold at 83c. per unit, seaboard, the highest price in many months. There is a distinct scarcity, the imports for the first quarter having averaged only 14,846 tons per month or the lowest in seven years.

Manganese-Iron Alloys: Because of the failure of some producers to deliver ferro-manganese on contracts as due, some consumers are reported to be seeking other supplies and therefore the demand for early delivery is a little brisker. For this position \$250 is asked and easily obtained when the alloy is available. For last half quotations are unchanged at \$200, delivered, for domestic alloy, and \$195, seaboard, for a limited quantity of British alloy for shipment during August and later. The situation in Great Britain is such that calcium silicide is being used as a substitute for ferro-manganese as well as certain silico-manganese alloys. The Anaconda Copper Co. is understood to have in operation a fourth electric furnace making ferro-manganese.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, MAY 29, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page		Page
EDITORIAL		COPPER AND COPPERAS	
NOTES	779	By Geo. O. Deshler	788
THE STRATEGY OF MINERALS	780	The metallurgy of a 'near-engineer'.	
Report by the Assistant Secretary of State on restrictions upon American enterprise in foreign countries. British policy toward alien oil companies. Treatment of Americans in Mexico. The Leasing Act and its reservations in favor of our citizens. The Canadian policy, and its generosity in this regard. What is the purpose of these restrictions? A mistaken idea.		ARTICLES	
A DISTINCTION AND A MORAL	781	THE NEW MOODERFONTEIN MILL	789
Two classes of employees. The disparity in remuneration. The backwardness of the salaried man in asking for more. A belated effort to correct inequalities. Cost of engineering supervision. Salaries for intermediate positions. Necessity for a competent technical staff.		The crushing plant. The work of 2000-lb. Nissen stamps; 30-ton duty through 9-mesh screen. Amalgamation. Classification. Leaching; continuous agitation of slime.	
DISCUSSION		THE BUNKER HILL ENTERPRISE—X	
OUR ANNIVERSARY		By T. A. Rickard	791
By Edgar Hall	783	Litigation instituted by the Guggenheims. Some intricate problems in apex rights. The Stemwinder and King Extralateral decisions. Transactions with various smelting companies. Sale of the Tacoma smelter and the contract with the A. S. & R. Co. Building of the Bunker Hill smelter. The cost of betterments. Mr. Bradley's connection with the company. Some photographs.	
A paper unique among technical journals. Congratulations from Australia.		THE CORTEZ MINE TO BE RE-OPENED	
COMPLEX ORES IN CALIFORNIA		Special Correspondence	803
By A. H. Heller	783	Early history of the property. Production. Present plans.	
Misapprehension regarding shut-down at the Afterthought mine. The true reasons. Possibilities in the electrolytic process. Zinc oxide or zinc sulphate. The Horwood process.		NOTES	
By W. L. Austin	786	METAL-MINE ACCOUNTING	804
Comparison of Afterthought ore with others. The expense of recovering zinc. A way of attacking the problem. Utilization of sulphur content of the ore. Production of zinc salts instead of spelter.		DEPARTMENTS	
By J. W. Beckman	787	REVIEW OF MINING	805
The advantages of electric smelting. Utilization of the hydro-electric resources of California.		THE MINING SUMMARY	811
		PERSONAL	812
		THE METAL MARKET	813
		EASTERN METAL MARKET	814
		COMPANY REPORTS	815
		BOOK REVIEWS	816
		INDUSTRIAL PROGRESS	817

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.

Flotation

Ruth Flotation Machine

Crushing

McCool Pulverizer

Concentrating

Laboratory Wilfley

Massco Equipment

For a Complete Laboratory Mill

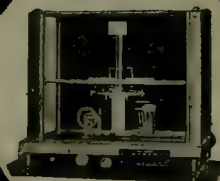
Assaying

Massco Clay Goods

WHY not reproduce milling conditions in the laboratory and make thorough tests of treatment methods before expensive new installations are made? The Massco line includes every necessity for a complete laboratory mill and conditions can be duplicated exactly.

A Massco Laboratory Mill is a safe, paying investment. It will return its cost many times in savings effected—Massco guarantees of satisfactory performance stand behind every piece of apparatus sold.

The Massco line includes everything in laboratory equipment, assay supplies, chemicals and precision instruments. Catalog describing the entire line or separate bulletins on any specialties in which you may be interested will be gladly sent on request.

Weighing

Heusser Balance

The Mine & Smelter

Supply Company

DENVER · EL PASO · SALT LAKE CITY · NEW YORK





T. A. RICKARD, . . . Editor

SAN FRANCISCO has been the place of meeting for many conventions lately; a few days ago the World Metric Standardization Conference was in session here. A large number of addresses were read in advocacy of the adoption of the metric system. It seems obvious that the change should be made and that the longer it is postponed the costlier it will be; but the item of chief interest concerning this convention is the fact that Mrs. E. L. Stephens of Bakersfield received a prize of \$1000 for the coining of a word to express the idea of "The United States and Britannia in unison in world measurements and weights". Our informant spelled it "Brittania", probably in order to justify Mrs. Stephens, who was the first to suggest 'Unitania'. The lady of Bakersfield found an easy way of making a little honest money.

VENUSTIANO CARRANZA was no friend of the United States or of American miners, but his ending by a hideous assassination is bad news. We are glad that General Obregon deplores the act and condemns those who ought to have defended their chief. The most pitiable feature of the crime is the fact that nobody seems to know for certain on which side, Federal or revolutionary, the assassin, Colonel Rodolfo Herrero, stood. Apparently the First Chief, as he called himself, was the victim of one of those acts of cowardly murder that have been so numerous since Diaz was ousted from office ten years ago. We hope that Obregon and his friends will be able to prove their detachment from the crime of Tlaxcaltenango, so that the new regime may not be stained at its start as was Huerta's, for complicity in Carranza's death would compel the United States to refuse recognition of the *de facto* government now apparently securely established in Mexico. The outlook for a general resumption of mining in Mexico is good.

IN his valedictory letter, on resigning as Director of the U. S. Bureau of Mines, Mr. Manning took the opportunity to express his regret that those in the Government service, more particularly in the scientific departments of its administration, are paid so inadequately that they are compelled to accept the tempting offers made to them to enter the service of corporations. Although "the Government spends each year many millions of dollars in useful scientific work for the benefit of the whole people", it does not recognize the service of its scientific and technical servants so as to enable them to remain in

its service. The money wasted in Government publications of a useless character, particularly in the printing of piffle in the 'Congressional Record', and in documents designed to minister to the glory of inconsequent individuals, would go far to correct the insufficient salaries of the staffs in the Bureau of Mines and the Geological Survey.

CONCERTED determination on the part of the mining companies at Butte to rid the mines of members of the Industrial Workers of the World, even if some of the properties are compelled to suspend operations for a time, is the result of the recent strike, which was declared off by the I. W. W. members on May 13. The resolution that ended the strike provided that the fight be again transferred to the 'job', which means that the men return to work, but resume with renewed energy the system of sabotage that the self-appointed leaders promise will finally weaken the industry to such an extent that the 'fellow-workers' can seize and operate the mines for their own benefit. On April 2 a mob of strikers collected on Anaconda road for the avowed purpose of preventing anyone, even mechanics, engineers, and shift-bosses, from going to work. The sheriff of Silver Bow county, with a small force of deputies, endeavored to persuade the crowd to disperse. Several fights started and presently a shot was fired, whether by one of the mob or by a deputy sheriff was not established. This started a fusillade, lasting several minutes, in which eight or nine of the crowd were wounded. Later Thomas Manning, one of the strikers, died in a hospital of a gunshot wound presumably received in the riot. The immediate effect was to stop the picketing, which had been unusually aggressive, and the vicious defiance of the strikers, which had intimidated practically all the men who wanted to go to work, disappeared abruptly. Evidence introduced at the inquest on the death of Manning revealed the real principles and plans of the I. W. W. organization. A special agent of the Department of Justice, who in the discharge of his duty attended meetings of the strikers, testified as to the threats of violence made at these sessions, and introduced as evidence copies of 'Solidarity', 'The Revolutionary I. W. W.', 'Sabotage, Its History, Philosophy and Functions', and other radical literature that he had obtained at union headquarters. More than a dozen members of the mob, who were presumed to refute the testimony of the sheriff and his deputies,

admitted that the average of their daily earnings had been more than \$7.50, while \$9.72, \$9.37, and \$8.96 were among the individual averages. Still, they were alleged to be striking for \$7 per day. This is explained by the evidence of three I. W. W. organizers, who frankly declared that even \$15 per day would not be acceptable to the men. The strike, both off the job and on, is simply a weapon in a class war; the object is to cripple the industry with the ultimate purpose of taking possession of the mines by a soviet. As we have said before, a large majority of the miners at Butte are ready and anxious to work under present conditions and at the prevailing wage; moreover, that these conditions and wages are acceptable is, in effect, admitted by the agitators themselves. It is obviously to the advantage of both employers and the law-abiding miners that the individual members of the I. W. W. be shut out of the mines. While it will be impossible to identify all of them, and while some injustice may be done in barring men who are not members, the companies are right in refusing to employ any man to whom suspicion points as being an exponent, even if only as an unfortunate dupe, of the vicious principles for which the I. W. W. stand—namely, sabotage, violence, anarchy, and government by a soviet minority.

ON another page we publish a description of the new mill at the Modderfontein mine, which is the greatest gold mine in the world today. The notable features of this mill are (1) the use of Nissen stamps, (2) the gravity flow of all the pulp from the stamps to amalgamated plates so that only one elevation of pulp is required, (3) the continuous treatment of the slime in Dorr thickeners and Brown agitators (or pachucas), and (4) the complete separation of slime from sand by classification, followed by the collecting of the sand and its treatment in the same vat, as at the Homestake. We understand that Mr. Francis L. Bosqui, formerly of California, was consulting metallurgist to the company at the time the scheme of treatment was devised. The Nissen stamp has averaged a duty of 30 tons per day through 9-mesh screens for the last four years. To do this it has consumed 4.06 horse-power. It has reduced the cost of crushing on the Rand 24 cents per ton for power alone. While we have had reason formerly to criticize the self-complacency of South African millmen, it must be confessed that they have not disregarded the lesson of the experiment with the Giesecke ball-mill in 1911. They have been willing to accept suggestions from the outside in regard to the bettering of their stamp-milling practice and even to give a fair trial to the Nissen single-stamp battery after it had gone out of favor in this country. The Nissen stamp is being used successfully at the Falcon and Shamva mines in Rhodesia. It is strange, to say the least, that it was not considered in the design of the Gastineau and Juneau mills, in Alaska, particularly of the latter. Instead, ball-mills borrowed from cement practice were bought in a hurry and a plant was erected that has been undergoing remodeling ever since. The Nissen stamp is the inven-

tion of that excellent engineer and gallant soldier, Mr. P. N. Nissen; it was used in the Boston Consolidated mill, at Garfield, 15 years ago, but never seemed to become popular in the United States. The remarkable success of this crushing machine at the Modderfontein should arouse the intelligent curiosity of our Western millmen.

The Strategy of Minerals

On May 17 a special report, prepared by Mr. Frank L. Polk, Assistant Secretary in the Department of State, was presented to the Senate, by order of the President, on the subject of restrictions upon American participation in the oil industry of foreign countries. The information was confined largely to conditions existing under the British flag. The report outlined British policy as follows: (1) To deter foreign nationals from owning or operating oil-wells in the British dominions; (2) the Government to participate directly in financing the larger oil-ventures; and (3) to prevent British companies from selling their property or transferring their shares in British-owned companies to foreigners.

Of course, these restrictions are not aimed at Americans particularly, but are directed against aliens generally. In Mexico, the report says, it has been found necessary to send a warning against any procedure resulting in confiscation of American oil-holdings. The Mexican threat to confiscate, however, has aroused much less interest than the disclosure of British policy, which, says the report, "would seem to be justified from the viewpoint of international law, however impolitic it might be as regards reciprocity and international comity". We think the policy is mistaken as a matter of national economics and we consider it regrettable for its effect upon international good-will. Before proceeding to discuss further the question of American enterprise on British oilfields, let us turn to the Leasing Act recently promulgated for the exploitation of our own oil resources. This Act restricts the leasing of land containing oil, coal, and phosphate to citizens of the United States and to corporations organized under the laws of the United States; further, "citizens of another country, the laws, customs, or regulations of which, deny similar or like privileges to citizens or corporations of this country, shall not by stock ownership, stock holdings, or stock control, own any interest in any lease acquired under the provisions of this Act". This seems eminently fair, and, as yet, no report has been made to the British parliament suggesting that it is not. Under our mining regulations, no alien can locate a claim; in Canada, an American has an equal right with a Canadian to locate mining claims, this privilege being denied only to enemy aliens, that is, the Germans and their late partners in the War.

What is the purpose of these international restrictions? To preserve a national resource for the national benefit, we presume. Do the restrictions fulfill this purpose? We think not. If an oil-well in Burma is productive, it should make no difference to the British government, it seems to us, as to who owns or operates it, provided the product goes to the British market, for use, let us say, by

the British navy. If the well is owned by an American company, the product will still go to the British market, which, we believe, offers the best price to anyone operating in Burma. On the other hand, if a British company controls oil-land in California, its product is sold in this State, and the producer has nothing to say in regard to its ultimate destination; the distribution of the oil is in American hands. It would be right and proper, from an economic standpoint, if the governments of the United States and Great Britain were to insist that the oil produced in their territory must be rendered available for the use of their own people by sale in their own market; but the embargo upon the participation of foreigners in the exploitation of the mineral is illogical. Take the case of the oil-well in Burma. It should not matter to the British government whether the winning of the oil be in British or foreign hands, provided the oil resources of Burma were not being exhausted for the benefit of a foreign nation. If American capital be at the back of the enterprise, it should not be begrudged a reasonable return. After all, in the aggregate there is more money put into metal mines and oil-wells than is taken out of them; we hear much about the lucky ones; we forget the unlucky. Much more British capital, for example, has been put into mining enterprises in this country than has been taken out as profit; of that there is no question. It is not often that the entire capital of a mining enterprise (which includes oil) is recovered in profit, plus interest on the outlay. Many Americans in the British dominions and many Britons in the United States have spent their substance in unavailing search for sudden wealth. The few prosper greatly, the many have the meagre satisfaction of helping to develop the waste, or the lonesome, places on the map. If our known oil resources are insufficient, if we are threatened with a scarcity of this valuable mineral, then it were provident to prevent the exportation of it to foreign countries, that is, the consumption of it by any but our own people; but it does not matter who is engaged in the actual winning of it from the ground, unless, of course, the foreigner's participation in the enterprise excludes domestic capital from a profitable opportunity. This rarely happens. As a matter of fact, the purchase of mineral lands by foreigners, whether in Burma or California, helps the residents by augmenting the price of local property and by bringing capital into the district, where this capital becomes so securely anchored that most of it remains, for the benefit of the district and the State. To come to bedrock, it does not matter who exhausts a national resource, such as oil, wastefully, whether it be a citizen or an alien. It is squandered, from a narrowly national standpoint, if more is produced than is consumed domestically. That is true if oil, for example, is more valuable to our people than the things that we obtain in exchange for the oil we sell abroad. The whole world is suffering from shell-shock; the peoples and their governments show a meanness of spirit in pitiful contrast with the fine emotions evoked by the War. It would be more logical, if, instead of imposing restrictions, or kicking at

those imposed by others, we were to go forth into foreign lands ourselves and engage in mining there, leaving our own mineral resources intact for the benefit of our American posterity. That sounds whimsical, but it is more reasonable than the policies adopted by the two English-speaking governments. The fact remains that the United States is the creditor nation of the world today; its manifest destiny therefore is to engage in foreign exploitation; the logic of events will render it advantageous for all concerned to facilitate American mining enterprise outside the United States. It should be our policy, therefore, to remove restrictions upon foreign undertakings in our country, because, to be frank, such enterprise, owing to the financial conditions prevailing in Europe, is likely to be much smaller in scope than our own enterprise in foreign parts. It should be the policy of our Government to encourage our nationals to exploit the mineral resources of foreign lands and to give its utmost protection to its citizens in doing such useful work.

A Distinction and a Moral

Employees of industrial companies may be divided into two fairly distinct classes: (1) those who have an appointment and draw a salary; (2) those who have a job and receive wages. Speaking generally, the members of the first group wear white collars, whereas the wage-earners, by and large, are content with an article of apparel commonly known as a 'work-shirt', the distinguishing characteristic of which is a permanently attached collar of the same material as the shirt itself. It has always been true that of two equally competent and experienced men the one who wore the white collar was paid less money, for the reason that the ratio of supply to demand was generally greater in his kind of work. For instance, when the plumber and the miner got \$4 per day, the bank clerk and the assayer were paid \$90 per month. This difference, to a large extent, is justified by the greater likelihood of advancement for the salaried man; his position is a stepping-stone to the place of the well-paid executive. A committee of Engineering Council, in a recent report, calls attention to a subtle difference between the 'cost of living' and the 'value of the dollar'. The committee believes that many classes of salaried engineers and technical men refrain from pressing claims for increased compensation on the ground that they are unable to live in the style to which they have been accustomed, simply because they feel it undignified to ventilate a matter that is in the nature of a private affair; they believe that it would not be worthy of their white-collared status. If, however, the question is put in the light of a change in the value of the dollar, the position is taken that the engineer may properly maintain that he is entitled to a sufficient increase in pay to make his remuneration equivalent in purchasing power to what it was five years ago. This is a nice distinction, yet it is worth thinking about. The fact remains that the changes due to the War have created a much greater disparity between the earnings of the man

who works by the day and of the man who works by the month. The wage-earners have demanded and received increases out of proportion to those of the salaried men. As an illustration, sub-foremen in the shipyards are paid at the rate of \$2900 per year, whereas marine designing-engineers in responsible positions are paid but \$2400, which is approximately equivalent to the income of an ordinary journeyman in many of the metal trades connected with the shipyards. Assayers, chemists, draughtsmen, surveyors, and junior engineers employed at mines and metallurgical plants are generally salaried men, and, while a somewhat similar situation obtains in the mining industry as is found in the shipyards, many companies have provided for employees of this kind, to some extent at least, by means either of bonuses or of outright increases in salary. Some companies doubtless have taken advantage of the over-supply of technically trained men, coupled with their characteristic backwardness in asking for more, to avoid giving deserved increases of pay. Such a policy, if continued, can have but one ultimate result, namely, a definite deterioration in the type of men who will select such work for a career. While all young engineers hope to become high-salaried mine-managers and consultants, not many achieve their ambition; therefore there must be a prospect of reasonable remuneration somewhere below the top. The Federal, State, and municipal governments have always been notorious for the low salaries they pay technical men, and the disparity between Government and private salaries has been emphasized during recent years. One immediate result has been as many as seven resignations from the U. S. Geological Survey in one week, while the Canadian Survey has been decimated. A belated effort is being made to correct this manifest inequality. An amendment to the Rivers and Harbors Bill has been proposed in the Senate providing for an increase of 25% in the prevailing salaries of assistant and junior engineers and chief clerks employed on all work related to the improvement of rivers and harbors and the construction of fortifications. This has been done at the solicitation of the American Association of Engineers. The St. Louis chapter of this organization was recently instrumental in causing an advanced schedule of salaries to be adopted by the board of aldermen, for determining the remuneration payable to all engineering and technical employees of the municipality. It appears that when the essential facts, including a comparison with the prevailing rates elsewhere, were presented in a comprehensive and logical way, the board was convinced that the employees were entitled to the increase for which they asked. There is one phase of this subject that is rarely appreciated, although it concerns directly the financial success of the employer. The cost of the engineering supervision of any enterprise, whether it involve construction, maintenance, or operation, represents only a small part of the total expenditure. The proportion, of course, varies between wide limits, but 5% may be taken as an approximate average. If, then, as a result of increased competence on the part of the

engineering and technical staff the efficiency of operations as a whole be increased by only 1%, the saving would be sufficient to provide an addition of 20% in the compensation of the engineers; and, as the engineering is a vital factor in the economics of an undertaking, the wisdom of obtaining the best available men, even in the minor positions, becomes apparent. For instance, a second-rate transit-man at \$150, in the course of a month may be responsible for waste in the time of common laborers amounting to thousands of dollars. Nor need he necessarily make gross or obvious blunders, for which he may be discharged; the loss may simply result from lack of foresight, from ineptitude, or, perhaps, from minor errors, all of which a higher-grade man at \$250 per month would avoid as a matter of course. And yet some employers 'economize' on engineers because they can; whereas the wage-scale of the laborer is fixed by agreement with unions or by the prevailing rate in a particular locality and does not offer opportunity for cheeseparing. There are, of course, certain positions, which are commonly held by young men, generally recent graduates from the technical schools, that are in the nature of apprenticeships. As a rule these boys have no family responsibilities and at any rate they expect to remain in such positions only temporarily on the way to posts of greater importance. It is reasonable—in fact, it is fortunate—that such positions should pay small salaries. It is in the intermediate grade of position, in which we find the average man who does his semi-routine work well, but has not the qualifications of initiative or personality to fill the place of the more fortunate specialist or executive, that the difficulty arises most frequently. These are the men on whose loyalty the employer feels he can count; they are educated and informed; they compose a large part of the substantial middle class in every community; they come under the category of 'white collar' men; and commonly it is these who have been accorded less consideration than any other class in the adjustment of salaries to keep step with increased prices. It may be argued that considerations other than salary make such work more desirable, so that it is unnecessary to pay more. The theory may be advanced that the law of supply and demand regulates what must be paid and that the same man would not be more efficient if his salary were increased by 25%. This brings us back to the crux of the whole question, namely, the necessity for adequate compensation to prevent inevitable deterioration in the type of man who will train himself for an important and necessary kind of work. The process of devolution may be slow, but it will become sure unless a sufficiently attractive future is to be expected by those whom it affects. Applying this reasoning to mining engineering, in which we are more directly concerned, can the manager afford to take the risk? The efficient conduct of his business depends largely, and directly, on the competence of his technical staff. In the interests of his stockholders he must maintain the standard of that part of his organization which is symbolized by the wearing of the white collar.



Our Anniversary

The Editor:

Sir—So the 'Mining and Scientific Press' is sixty years of age, and is going to issue a diamond jubilee number on its birthday!

No one would believe it is so old by its appearance, for, surely, it is brighter and prettier and more energetic and cheerful than ever it was before. My memory of it goes back 30 years, during which I have been, more or less—chiefly more—one of its regular readers and admirers, and it seems to me to be growing younger. May I quote something I read recently which may explain the phenomenon? It must be that "at 60 it has the love of youth so clearly in its breast, that it can never cross the line to age". And it never will grow old so long as it possesses the high ideals of conduct, sincerity, and truth that guide its production, and for which it is read and honored.

The paper is unique among technical journals in that the professional aspect is not its only one; that there is another side to the mining engineer than the business side is not forgotten, and it is the remembrance of that which attracts us to its pages. As no profession involves a wider acquaintance with the application of the sciences and the arts to the exploitation of Nature's wealth, and as none leads a man through more varied scenes of beauty and grandeur, and of desolation and barrenness, so none, not excepting the physician's, brings one into contact with so many varieties of mankind, as does that of the mining engineer in our time. So we should have the human side of life presented to us, and it is fine that our weekly mining journal should remind us that men have minds and souls, as well as brains and muscles, and that the development of brain and muscle is not the only object to which the mining engineer should devote his life.

As an Australian reader, it is a pleasure to send greetings and the best good wishes to the 'Mining and Scientific Press' on its attaining 60 years of age, and to testify to the excellence of its writing, its printing, and its illustrations: the last are noteworthy among journals, not photographs only, but veritable works of art are they. The Editor we always knew as an artist in words; of late years he has shown us that he has also the artist's eye for scenery.

What else is there to add? Mining engineer, geologist, journalist, poet, preacher, artist, gentleman—the 'M. & S. P.' aims at making the first comprise all the rest.

May it succeed, and remain ever in the forefront of youth, and so "never cross the line to age".

With sincere congratulations and warm personal thanks for the knowledge gained and the pleasures enjoyed over many years' perusal of its pages by one, at least, of its trans-Pacific readers.

EDGAR HALL.

Silverspur, Queensland, March 30.

Complex Ores in California

The Editor:

Sir—I have read your article on the treatment of complex ores in California, wherein you make special reference to metallurgical operations at the Afterthought copper mine. As your article creates somewhat of a false impression regarding the operations of that company, I will endeavor to answer it and clear up a few points in question.

First you speak of the failure of all metallurgical processes so far tried on Afterthought ores. These processes were no more failures than any proved simple process is a failure that must be discontinued owing to a rise in the cost of treatment or in freight-rates, or a drop in the market-value of the metals produced.

There is nothing really difficult in the treatment of complex ores in California, and a number of processes are available for almost every one that we have in this State. The kind of process to be used is dependent on the situation of the property, the character of the ore, and the quantity of ore in reserve. As a rule the most economical process from which the greatest recovery might be expected is the one with which is connected the most extensive plant or initial cost, but the amount of money that can be safely expended on a plant is dependent upon the quantity and grade of ore developed.

As regards the Afterthought ore, which is similar to the Bully Hill and other Shasta county ores, it is one that cannot be concentrated successfully by gravity methods owing to the extreme fineness of the sulphides and the presence of barite and a large amount of pyrite. At the Afterthought successful results were obtained with hot-blast smelting, between 1905 and 1907, on the upper-level ore which was more or less sorted so as to obtain a minimum amount of zinc with a maximum amount of copper. As the zinc content of the ore-reserve increased, this method of smelting became out of the question.

S. E. Bretherton, who was in charge of the property at the time, made experiments with ammonia leaching. He obtained good results and made progress on a small

scale. At that time, however, there was no mill so that the residue from his leaching would be low in copper. Moreover, since there was no reverberatory furnace, nodulizing, briquetting, or sintering would be necessary before the ore could be smelted in the blast-furnace. If the ammonia process had been used at this time in conjunction with a mill and reverberatory, there is no doubt in my mind that the process would have been a success, since concentration would have given a residue carrying more than twice the amount of copper that could be obtained from crude-ore treatment, and the residue could then have been fed direct to the reverberatory. Then again, the waste heat obtained from the reverberatory could have been utilized for distillation purposes, as the steam required for distillation is one of the largest items in the cost of the ammonia process, as is shown by work now being done with this process on copper ores.

The Afterthought mine remained idle until 1917, when J. F. Milliken, of St. Louis, undertook to operate it under the direction of John Tait Milliken, his consulting engineer. Extensive tests were carried on with a view to finding the most economical process for this ore, and I understand that two stood out above all the rest, namely, the Horwood process and the electrolytic method. Tests carried on by competent engineering companies, with a view to employing some wet selective method, such as the Bradford process, proved failures. The electrolytic method as applied to zinc ores was in the first stages of its commercial development, and reports from companies trying this process at the time were far from encouraging. It seemed far too expensive for any pioneering work. We know now that the Anaconda Copper Co. alone has spent millions in the development of this process and the building of a plant. From the start the Horwood process gave exceptional results on a small scale, and although it was realized that a certain amount of pioneer work would be necessary, it was the only process that seemed available at the time. After about six months of running the Horwood process was developed to a point where it could be called a real commercial one for ores such as the Afterthought, for, contrary to an idea prevalent among the mining public, the process is no more difficult of operation than the average complex-ore method.

During this time the electrolytic process was making headway at other plants, and, knowing that if it were once developed it would offer greater possibilities than any concentration method, all the equipment was so chosen and erected that it could be utilized at some future date for electrolytic work in case the management found it desirable to make the change. Another point that should be mentioned in this connection is that at this time the ore-reserve did not warrant the great expenditure which would have been necessary in the installation of the electrolytic process, whereas it was thought that profitable operations could be carried on with the Horwood process while further developing the mine.

Before making final changes, which were necessary in order to put the plant on a profitable basis, J. T. Milliken

died. Operations were at a standstill for about eight months, although during this time a smelter, which had been started before Mr. Milliken's death, was completed, the intention being to handle the residue or copper concentrate from the preferential process. By the time the smelter was completed a number of factors had intervened, which not only made the Horwood, but all other concentration processes out of the question. Up to the year 1919 it was possible to realize, on a concentrate containing 45% zinc, 8 oz. silver, and 3% copper, approximately \$25 per ton after deducting smelting and freight charges to Oklahoma. This was on a market-value of zinc at 7½c. per lb., silver at 50c. per oz., and copper at 15c. per lb. But throughout the greater part of 1919 and especially during the past few months with the same grade of concentrate and a market-value of the metals much higher than the above quotations, the product was practically worthless. This was due to a rise in the cost of smelting zinc concentrate, and an absolute refusal by all zinc-smelters approached to pay for any silver or copper contained in the ore. These are the main reasons for the suspension of operations by a concentration process at the Afterthought mine. Had Mr. Milliken lived, he undoubtedly would have financed the construction of an electrolytic plant in the spring of 1919. Had conditions remained more normal as regards the disposal of the zinc concentrate, any small difficulties of operation at the present plant could have been worked out, and not only could the mine have been developed, from the profits of the operation, but an electrolytic plant and all other needed construction would have been possible.

When it became evident that it was not profitable to market the zinc concentrate, all efforts at preferential flotation were discontinued, and in order to assist development in the mine and to determine the practicability of smelting a charge similar to that derived from an electrolytic plant, it was decided to make a collective concentrate and smelt it direct in the reverberatory furnace, shipping only copper matte. In all cases where a residue from an electrolytic plant has been smelted, it has been mixed with other ores so as to bring down the proportion of zinc in the charge. Some doubts were expressed by metallurgists experienced in electrolytic work as to whether or not a zinc-plant residue, which might at times contain as high as 16% zinc, could be smelted directly in a reverberatory furnace. The Afterthought management felt sure that if a collective concentrate, containing a high percentage of sulphur, as compared with the sulphur present in an electrolytic residue, could be smelted, there would be no doubt of their being able to treat this material. In the first few months of operation some little trouble was experienced, while running on charges containing not more than 12% zinc, but this was traced to sources other than the presence of zinc, and during the last few months operations were absolutely smooth although the zinc content of the charge seldom dropped below 17% and for weeks at a time it averaged well above 20%.

The above process at its best was wasteful, as the zinc

content of the crude ore in the mine averages above 16% and has a higher gross value than all the other metals combined. For this reason, after determining that it was an easy matter to smelt an electrolytic residue, it was deemed advisable to suspend operations until an electrolytic plant could be built, notwithstanding the fact that during the last couple of months of operations a profit was realized on the sale of copper matte alone.

Such is a summary of the history of metallurgical operations at the Afterthought mine. Experimental and investigation work was constantly going on, not only on processes that were being used commercially at other plants, but on practically every new process that came to our attention and that seemed to have any merit. Among these processes were electrolytic zinc, concentration smelting, ammonia leaching, magnetic separation, Bradford, Terry, and other selective methods, volatilization, and various leaching and digestion methods with chemical precipitation. Samples were sent out constantly upon requests of individuals or corporations that claimed they had a process which would more successfully treat the Afterthought ore than any other that we had investigated. To my knowledge, not one of these individuals or corporations was heard from again. Wet preferential flotation by the use of reagents was given a thorough test on a large scale in order to compare it with the Horwood process, but it proved inferior for this particular type of ore.

The decision that the electrolytic process was the best known commercial process for Afterthought ore was based on the following:

1. The character of the ore is nearly ideal for this particular process. There is a complete absence of such metals as cadmium, nickel, bismuth, cobalt, vanadium, arsenic, and antimony. Analysis of concentrated fume from the smelter failed to show even a trace of these metals. In an experimental test-run at Anaconda on Afterthought ore a zinc cathode 99.9% pure was obtained without any purification.

2. The cost of power, one of the main items in electrolytic work, is very reasonable at the Afterthought plant.

3. The electrolytic process has been so fully developed that no pioneering work would be needed on an ore containing so few impurities.

4. All equipment at the Afterthought plant can be utilized to advantage in connection with an electrolytic plant.

5. If a demand for zinc oxide or the salts of zinc should arise, they could easily be obtained by by-passing part of the leach-solution.

California is in need of either a custom zinc-plant situated near some cheap fuel-supply, such as the San Joaquin oil-field, or a custom electrolytic plant where cheap power is available. This would not only stimulate renewed activity at all the larger properties, but the smaller ones throughout the State would be in a position to concentrate their ores, for the Californian mines that warrant other than concentrating plants are few in number. With an outlet to a near-by zinc-smelter, preferential methods would no doubt be necessary in most cases

in order to obtain a concentrate high enough in zinc; but with an outlet to an electrolytic plant, the cheaper collective method of flotation would afford all the preliminary treatment necessary, as a far lower grade of ore can be treated profitably in an electrolytic plant than is possible at a smelter. The only drawback to a custom electrolytic plant is the variety of impurities, which would change constantly with different lots of ore, and would add to the cost of treatment.

There are other processes by which products such as zinc oxide or sulphate might be obtained, instead of a concentrate or spelter; many of them are promising, but very few have been demonstrated successfully on a working basis. It is my opinion that if one were producing upward of 30 tons of zinc oxide daily, a market would be hard to find, although of late, through the activities of the New Jersey Zinc Co., a considerable market for this material is being created. In Colorado there was an example of concentration smelting carried on successfully, but only part of the zinc oxide produced was marketed, the rest was treated in Iowa by electrolytic methods. With an electrolytic plant one could easily switch part of the zinc-sulphate solution, to be treated separately by certain chemicals, such as the basic or alkali carbonates, to form zinc carbonate, which could then be calcined to zinc oxide. Or if there is a demand for zinc sulphate, which commands a comparatively high price, it is a simple matter to obtain this salt by the use of evaporators such as are used in industrial chemical work. But if there be a big demand at present for the oxide and sulphate of zinc, why does not a progressive concern such as the Anaconda company utilize such simple methods to obtain these products from part of the leach-plant solution? We know from their work in making finished products that the management would take advantage of all such possible operations, if such products yielded more profit than the zinc deposited electrolytically.

You state in your editorial that in all accounts of operations at the Afterthought mine you have not seen to what extent zinc can be removed from the collective concentrate by giving it a sulphatizing roast, followed by leaching with acidified water derived from passing roaster-fume through suitable towers. You evidently have reference to the article printed a short time ago on a modification of the Horwood process in which this suggestion was made. As yet it has not been possible to obtain a complete sulphatizing roast with complex ores on a large scale. In electrolytic plants they work to obtain as much of the zinc in the sulphate form as is possible, but the proportion of zinc sulphate to zinc oxide so far has been very small. To leach out any appreciable amount of zinc oxide, the acidity of the leaching solution, I believe, would have to be much stronger than that obtained by merely passing the roaster-gases through simple absorption-towers. If one were to go so far as to erect an expensive plant to obtain sulphuric acid from the gases, one would not be as well off as if one had an electrolytic plant, in which very little, if any, sulphuric acid is added once the circuit is filled and the plant in operation, but by leaching and precipitating by

chemical means, fresh acid must always be added for the leaching.

As regards the above-mentioned article, in which the use of a slightly acidified solution is suggested for the Horwood method, one comes back to concentration processes. I have tried removing the small amounts of sulphates formed in roasting, but found that the copper sulphate in the pulp was absolutely necessary for subsequent flotation of the zinc sulphide. The pulp was very acid in reaction, but there was no apparent cleaning of any zinc oxide formed on the zinc-sulphide particles. Then, again, a point had been reached in Horwood practice when it was a simple matter to control the roast, so that no great amount of zinc sulphide was altered in roasting. Before the process was improved in this regard, the use of acid from the smallest to prohibitive amounts was tried, but no improvement was noticeable. At the same time there is no doubt that the suggestions offered might lead to some interesting refinements in the Horwood process.

This discussion refers mainly to the zinc-copper ores of the northern part of the State, but methods mentioned as being applicable to these ores should not differ radically from the treatment for the lead-zinc ores found in the southern counties. Although I have stated that for ores such as the Afterthought, the Horwood is the best concentration method, for lead-zinc complex ores I have found the Bradford to be the best preferential flotation method.

A. H. HELLER.

Ingot, California, May 12.

The Editor:

Sir—Referring to the editorial on this subject appearing in your issue of April 24, the failure to exploit many of the mines that produce ore of this character may be ascribed to causes in themselves complex. These ores may be difficult to treat; but the aggregate value of their component metals is high, and with hydro-electric power available along the Sierra and the markets of the world accessible by sea, the effort in seeking to make commercial use of this storehouse of potential wealth is justifiable.

In the table below are given the important ingredients of some ores and concentrates of the class mentioned.

Mine and district	Character of sample	Zinc %	Iron %	Copper %	Lead %	Insoluble %	Gold Oz.	Silver Oz.
Anaconda, Montana	Concentrate	30.1	16.1	1.86	9.1	4.7*	0.05	1.35
Afterthought, California	Flotation concentrate	21.2	16.1	4.3	..	14.4	..	7.0
Nassau, California	Ore	26.4	4.9	2.9	..	44.5	0.34	3.4
Steeple Rock, New Mexico	Table concentrate	39.1	...	5.0	7.5	...	0.06	4.2
Steeple Rock, New Mexico	Flotation concentrate	26.5	...	3.0	10.7	...	0.03	4.2
Magma, Arizona	Ore	18.0	15.2	3.9	..	36.2	0.21	19.0
Teziutlan, Mexico	Flotation concentrate	9.0	24.0	6.5	..	23.2	0.02	2.3

*SiO₂.

Assuming the prices of lead and zinc to be approximately equal, as they are at present, and that copper is worth double an equivalent weight of zinc, it is apparent from a glance at the table that the invoice-value of the

zinc in the products enumerated constitutes more than 50% of the total in most of the cases cited. Because of the large percentage of zinc present, it has become generally recognized that successful treatment of this class of material depends upon profitable extraction of the contained zinc. This has been accomplished under progressive managements elsewhere, for instance, at Great Falls, Montana; Trail, B. C.; and Park City, Utah. There appears to be no good reason why it should not be done in California, although it will be necessary in each case to meet local conditions by modifications of methods adopted in other places. Many valuable suggestions as to technical procedure in the metallurgical treatment of zincky ore have appeared in scientific publications and patent specifications from time to time. Although any one of the methods proposed may not possess in itself all the requisites necessary, intelligent combinations of features already worked out, coupled with exercise of some ingenuity in supplying deficiencies, will successfully meet requirements at most of the prominent mines.

Complex zinc-sulphide ore or concentrate is not looked upon with favor by metallurgical establishments that purchase custom ore, especially when these materials are in a fine state of division, as, for instance, flotation concentrate. Recently a sample of an ore of this kind from a West Coast mine was submitted to the purchasing agent of a prominent smelting company for a bid. This ore contained approximately 20% zinc, 20% lead, 5% copper, 3 oz. silver, and \$5 in gold. The result was a bid penalizing all the zinc over 8% at 50c. per unit, amounting to a charge of \$6 against the ore in addition to a smelting charge of \$7 per ton. The smelter-value of the copper, lead, silver, and gold was estimated at \$17.50, leaving a total of \$4.50 to the mine-owner for his ore delivered at the smelter. Out of this \$4.50, he would have to pay the cost of mining, freight, and all other expenses. There was nothing unusual about this bid; that is one of the principal reasons why this class of property is not being operated. The smelting company was not taking advantage of the miner; the plant at disposal is simply not adapted to handling complex zinc-sulphide ore to advantage and reduction charges have to be adjusted accordingly. The zinc that constituted one-fifth the weight of the ore in question had to be treated as a liability, not as an asset, and consequently the other metals

in the ore were called upon to meet costs due to the presence of an undesirable ingredient. Lead-smelters and copper-smelters do not desire a heavy zinc ore, for the reason that this metal interferes with their established

methods of treatment and occasional losses and additional expense. Zinc-smelters are similarly disposed toward complex ores carrying iron, lime, lead, and other elements that corrode their retorts, or are troublesome to recover at their plants. It is therefore apparent that such ores, or concentrated products, require special treatment by means of which recovery of the zinc in some commercial form is provided.

Writers on the subject have repeatedly stated that zinc requires more chemical or electrical energy, in comparison with its value after recovery, than almost any major metal on the market. With this established fact for guidance, resort to electrolysis as a means of producing spelter should only be made where cheap hydro-electric power is available in large quantity. This method is further handicapped by the high cost of an electrolytic plant and the necessity for pure solutions. However, when fuel is expensive, electric energy may sometimes be employed to advantage for bringing the metals into solution as chlorides. As a given quantity of chlorine will dissolve a greater weight of zinc than it will either copper or iron, the electric energy required for getting zinc into solution under favorable circumstances may be less than that required for leaching copper ore. As to the removal of the zinc from solution, the form of the product desired has an important bearing. In some places simple concentration by evaporation will suffice; much of the ordinary salt of commerce is produced by solar evaporation. This manner of concentrating leach-liquors is not expensive and may be supplemented by the use of roaster-gases or even resistance-coils.

Unfortunately there are no zinc smelters on the Pacific Coast to which zinc concentrate made from complex ore can be sold, and attempts to ship such material to distant metallurgical centres for treatment do not appear to have met with success. Low value of the zinc, heavy deductions from associated metals, and high freight-rates are against the disposal of the product.

From the records of attempts made to treat the complex sulphides of California it is apparent that neither electrolytic treatment of the purified solutions nor concentration by flotation quite cover the situation, but there remain other ways of attacking the problem. Such ore generally contains in itself the essentials for its economic reduction. The sulphur contents of complex ores usually suffice to maintain a roasting temperature in a suitable furnace, with addition of a comparatively small quantity of fuel, and the sulphur di-oxide of roaster-gases has been shown to be an excellent solvent for the zinc oxide in the roasted pulp. Granted these favorable conditions, the expense for chemical energy in getting the zinc into solution is reduced to a minimum. Several methods have been suggested for removing zinc from sulphide solutions, but it is not recalled that any serious attempt has yet been made to apply these methods under Californian conditions. The sulphite method may not be the best for the purpose, but it is mentioned in this connection because in using it the complex ore itself is made to supply the reagent for separating zinc from the metals associated with it. It contains promising features but prob-

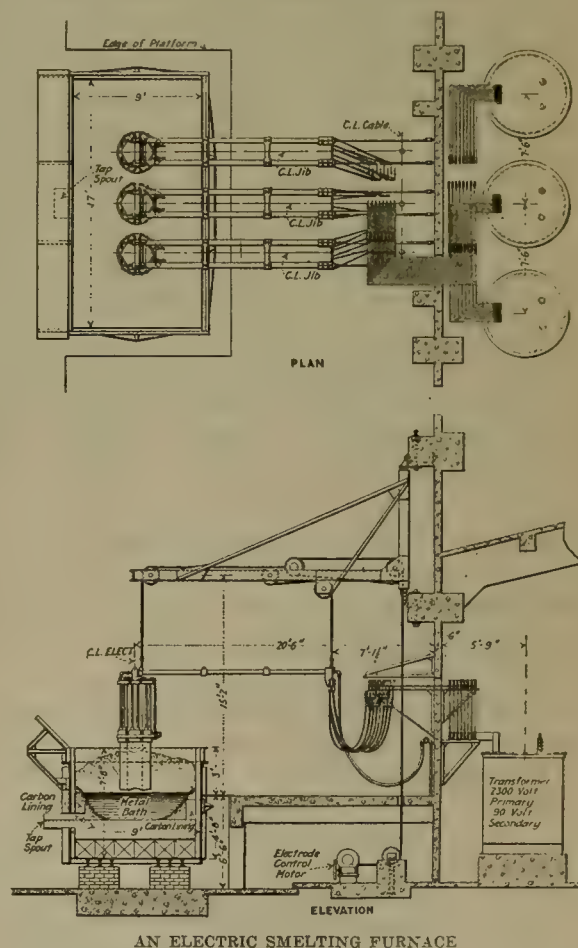
ably can be best applied in connection with parts of other processes, adapting the whole conditions which exist in the place where the ore is to be beneficiated. The combination should comprise: (1) utilization of the heat-units produced by combustion of the sulphur contained in the ore itself; (2) application of the roaster-gases toward removal of zinc from roasted ore, and for evaporation of solutions; (3) recovery of zinc from solution in the form of salts that have a greater value per pound of contained zinc than the same zinc would have if reduced to spelter.

W. L. AUSTIN.

Riverside, California, May 10.

The Editor:

Sir—Your recent editorial on this subject touches on a subject of vital importance not only to California but to many other localities on the globe where there are ore deposits of similar nature. All metallurgical processes have limitations, and apparently no process has as yet



AN ELECTRIC SMELTING FURNACE

been worked out which economically and efficiently handles these complex ores containing copper, lead, and zinc, together with gold and silver, be they located in California or in other parts of the world.

I have given the complex ores a great deal of consider-

ation and with the preliminary experiments and investigations which have been carried out in a laboratory in San Francisco, where a 100-kw. electric furnace is installed for experimental work, I believe that these complex ores can be successfully, efficiently, and economically smelted by means of the electric furnace.

The conditions which exist in an electric furnace are different from those which exist in any other type of furnace. The amount of burden present in the furnace at any time is small. Its composition can be changed at will, practically instantaneously, and, by slight modifications in the current and other operating conditions, such changes can be brought about in the furnace that it opens opportunities to the smelting of the greatest variety of ores.

In a general way, the mode which I believe should be followed in an electric furnace for the smelting of concentrates containing the metals would be as follows: By some suitable means, a reducing agent and a fluxing agent would be intimately mixed with the sulphides and placed in a furnace, where, actuated by the high electrical heat, the metals would be reduced. The volatile zinc would readily boil off and at the surface of the charge would burn into zinc oxide, which could be recovered by means of a bag-house or a suitable precipitator. The less volatile metals like copper, lead, gold, and silver, would all be recovered, in pig-metal, which later would be treated according to standard practice and the various metals recovered. Small amounts of these metals might be volatilized and would be recovered with the zinc oxide. These amounts would depend altogether on the operation of the furnace.

The economical way of smelting these ores in an electric furnace would be for the mine to utilize some small water-power in its proximity and in this manner obtain a cheap source of energy for the smelting of the ore. The value of the metals in the ores will determine what price for power a smelter operating an electric furnace can be justified in paying.

I believe that the electric smelting of this kind would foster the economical use and development of many small water-powers now going to waste. As said before, each individual ore would have to be studied and the operations modified according to its composition.

The accompanying sketch indicates in a general way the character of an electric furnace that would be used for the purpose of smelting such ores.

San Francisco, May 1.

J. W. BECKMAN.

Copper and Copperas

The Editor:

Sir—The article, 'Precious Metals in Oil-Shale', by Walter E. Burlingame, which appeared in your issue of May 8, recalls an episode that came to my attention a few years ago. It serves to illustrate the peculiar psychological effect which anything pertaining to mining seems to have upon men who otherwise are perfectly sober-minded.

The ore at a certain mine was supposed to contain

about 3% copper. It was roasted and leached with a solution of ferrous chloride, which was made at the plant by treating a solution of salt (sodium chloride) with copperas (ferrous sulphate). The mine-sampling had evidently been imperfectly done, as the mill-heads ran about 0.65% copper.

About this time, along came Mr. Near Engineer with a line of 'bull' which no mere engineer could hope to equal, and persuaded the directors that the engineers at the property were entirely wrong in their work, and that they were trying to shield themselves by putting copper in the solutions. He happened to see the barrels marked 'copperas' being dumped, and ferrous chloride does have a bluish-green color.

He also actually obtained a grant of \$5000, to demonstrate a process which he and a partner had "discovered". With this process, he claimed that he could extract not only the supposedly 3% in the ore, but an additional amount each time he treated the tailing!

To make the story short, the near-engineer turned out to be a bricklayer, his partner a druggist, and their leaching solution, a solution of blue vitriol, copper sulphate.

GEO. O. DESHLER.

Butte, Montana, May 12.

THE Matanuska coal-field, in Alaska, is just now of special interest because it is tributary to the Government railroad and because of the coal-mining developments carried on by the Alaskan Engineering Commission. The U. S. Geological Survey has therefore issued, in its Bulletin 712-E, a paper by Theodore Chapin, entitled 'Mining Developments in the Matanuska Coal Field'. Mr. Chapin is in charge of the branch office of the Geological Survey at Anchorage, Alaska, and is actively co-operating with the Alaskan Engineering Commission in the development of these mines. His report is part of the Geological Survey's regular annual account of mining in Alaska and is based on several weeks field work done at different times in the summer and fall of 1918 and on an intimate knowledge of the mining and prospecting that were done in that year. The report includes a brief description of the general geology of the coal-field, a statement of the results of tests and analyses of the coal, a detailed account of the mining and prospecting done in 1918, and descriptions of the geologic features at the mines, and maps of areas near them, as well as many sections showing the geologic relations of the coal-beds. The report is supplemental to the more general accounts of the geology and coal of the Matanuska valley that have already been published by the Geological Survey. The same bulletin contains also a short paper by Mr. Chapin entitled 'Lode Developments in the Willow Creek District', which is the customary brief annual statement of the developments of the year of the gold-lode mines of that district.

THE gold output of Rhodesia for February 1920 amounted to £250,020, as compared with £211,851 for January 1920, and £220,885 for February 1919.

The New Modderfontein Mill

*The ore from the mine is removed from the transfer-bin by two 24-in. inclined belt-conveyors, each 193 ft. long, running at 200 ft. per minute, driven by 25-hp. motors with reduction gears and provided with non-run-back stoppers on the free-wheel principle. The point of delivery into the crusher and sorting-house is situated 38 ft. above the level of the ground. The feature of this section is the thorough washing and the separation and dewatering of the fine by treatment in trommels. The ore first passes to three washing and sizing-trommels, each 5 ft. diam. and 20 ft. long, set at 10° from the horizontal and revolving at 10 r.p.m. The trommels are provided with holes of 3 and $1\frac{1}{2}$ in. diam. The oversize, after being thoroughly washed, is discharged from the trommels to the sorting-belts, of which there are three, each 3 ft. wide and 88 ft. long, running at 40 ft. per minute. Each is driven by a 15-hp. motor fitted with reduction gears.

The undersize from the trommels falls to three screening-trommels, each 5 ft. diam. and 12 ft. long, set on a horizontal axis and provided with internal screw-conveyors. The apertures of the screen are the same as those of the mill-screens. The washed fine is delivered onto a cross-belt, 24 in. wide and 55 ft. long, driven by a 5-hp. motor, and joins the product from the breakers. The products passing through the screens of the secondary trommels by-pass the mill and are classified, the oversize joining the pulp going to the tube-mills; and the undersize is collected in tanks and periodically sent to the cyanide annex, thereby avoiding irregular accessions of water, which are so detrimental to good classification. The six trommels are driven by one 25-hp. motor.

With this system of sizing and washing the following advantages are obtained:

- (1) A clean product for sorting is made.
- (2) Practically no material finer than the mill-screen is fed to the stamps.
- (3) The product is more suitable for belt-conveyance.
- (4) The water-system is confined to the sorting and crushing station only, and the limitations to its use are not governed by the cyanide-annex.

The sorting station itself is particularly well lighted, so that a large proportion of the ore may be sorted. The discarded waste-rock is collected by a number of pipes into bins, and conveyed by endless-belt haulage to the sand-dump. The ore is delivered at the end of the sorting-belts to four No. 6 'K' Gates gyratory belt-driven crushers, each connected to a 60-hp. motor. A fan withdraws any dust produced by these breakers. One crusher is set to the size required for the tube-mill pebbles, the product being screened and delivered by a cross-belt to a storage-bin. From here the pebbles are delivered when

required to the main mill-belt and by means of the shuttle-belt to the main storage-bin for pebbles, situated at one end of the stamp-mill bins. The main product delivered by the breakers falls onto a cross-belt, 3 ft. wide and 138 ft. long, running 150 ft. per minute and driven by a 15-hp. motor with reducing gear. This cross-belt discharges onto the main belt, which elevates the ore to the mill. The main belt is 3 ft. wide, 212 ft. long, runs 150 ft. per minute, and is driven by a 50-hp. motor. The angle of inclination is 16° from the horizontal and the ore is delivered onto a shuttle-belt at the top of the mill, 45 ft. above the level of the ground. The shuttle-belt, 3 ft. wide and 75 ft. long, being driven by a 10-hp. motor, controls the filling of the bins, which have a capacity of 2400 tons. The mill proper consists of fifty-six 2000-lb. Nissen stamps, each set of eight being driven by a 50-hp. motor. The feeders, one to each stamp, are of the fluted-roller type, having the advantage of simplicity of repairs and low cost of maintenance. The plant is capable of a duty of 30 tons per stamp per day through 9-mesh screens. The pulp passes over observation tables and gravitates through two systems of launders to the tube-mill cones, thereby saving pumps in connection with the tube-mill plant. This consists of eight tube-mills, 6 ft. diam. and 20 ft. 6 in. long, the working ratio being one mill to eight stamps, with one in reserve.

The mills are fitted with 5-ft. diam. Schmitt feeders, Osborne liners, and scoop-discharges, and there are arrangements for partitioning a compartment for balls if desired. The tubes are each driven by a 150-hp. motor and run at 28 r.p.m. The main tube-mill cones are 5 ft. diam. by 6 ft. 4 in. deep, and each set of two main cones has a secondary cone 3 ft. 6 in. diam. and 5 ft. deep coupled in series. Pebbles are prepared, as already stated, by one of the rock-breakers and conveyed to a bin at the end of the mill. From here they are carried in front of the tubes on a 12-in. belt, 147 ft. long, driven by a 5-hp. motor at a speed of 60 ft. per minute.

The pulp flows to the amalgamating department, which is arranged as an independent section, in that it is quite self-contained and partitioned from the rest of the plant. A gallery connecting the classification and pump sections with the crushing department runs overhead, and is of advantage in facilitating control, accessibility, and supervision. The copper plates are 40 in number, five per tube-mill; they are erected on angle-iron tables, with provisions for adjusting the inclination. The plates are 5 by 12 ft., with an effective surface of 53 sq. ft., equal to 12 sq. ft. of plate per ton of ore per 24 hours. The amalgam-traps are specially designed to occupy minimum space and are secured by the plate-covers to avoid a duplication of locks. After amalgamation the pulp runs to two 12-in. sand-pumps with a capacity of 1300 tons per hour against a 65-ft.

*Abstracted from pamphlet issued on the occasion of the visit of the South African technical societies to the plant.

head at 430 r.p.m. They are belt-driven from two 150-hp. motors. A sump of ample capacity guards against stoppages in the current supply. The pulp is thus lifted for the first time to a main distributing cone, 7 ft. 6 in. diam. and 7 ft. 6 in. deep, and thence to eight classifying cones, 3 ft. 6 in. diam. and 5 ft. deep. These cones are fitted with hydraulic devices and parallel sorting-columns, and the return gravitates back to four tube-mills for re-grinding. Provision is made for operating these four mills either as independent secondary circuits, or on a combination feed of primary and returned material.

The overflow passes to four cones, 7 ft. 6 in. diam. by 7 ft. deep, also fitted with hydraulic devices; these cones separate sand and slime. The position of these cones, quite near the ground-level, is a departure from usual practice; the slime reaching the Dorr thickeners by gravity, while the sand and water gravitate through a concrete conduit to a sump and are then pumped to the sand-plant. At this point comes the mill-water tank, which is remarkable, in that one structure carries the main steel tank, 50 ft. diam. and 12 ft. deep, within which is the cone-classifier service-tank, 15 by 12 ft., the mill-tank being supplied by the overflow from the inner tank, which receives the main supply. The inner tank also supports the Gland water-service tank, 12 by 6 ft. The four separating cones are also supported by this structure.

The sand and water taken as underflow from the separating cones are run to the main pump-house and elevated to the sand-laundry by means of 6-in. pumps of 300 tons capacity per hour against a 55-ft. head at 590 r.p.m. These pumps are belt-driven by 45-hp. motors. The tanks are eight in number, 52 ft. 6 in. diam. and 10 ft. 6 in. deep, with filter-bottoms and distributors. The sand is collected and treated without transfer, this being possible on account of the careful classification and the absence of danger from contamination of the mill-water by cyanide. The slime is collected in six Dorr thickeners, each tank being 40 by 12 ft. The tanks are fitted with stirrers and diaphragm-pumps, and the whole arrangement is one of the novel features of the plant. The production of thickened slime, containing 40% moisture with a working ratio of 1:13, solid: water, is continuous, and does away with the periodical sluicing, as is needed in intermittent collecting. The slime runs continuously in launders to the main pump-house, sufficient cyanide-solution being added to fulfil pumping requirements. By means of 6-in. pumps of 300 tons per hour capacity to a height of 55 ft. at 590 r.p.m., the slime is lifted to the

agitators, consisting of six standard Brown, or Pachuca, tanks, 15 ft. diam. by 45 ft. deep. They are arranged and connected to work singly, in series, or in parallel. After agitation the pulp gravitates to a 60 by 12-ft. stock-tank, fitted with stirring gear, and thence to the Butters filter, which consists of 300 leaves and has a capacity of 20,000 tons of dry slime per month. The stock solution is carried at a sufficient elevation in a 40 by 12-ft. tank.

The vacuum in the filter is created by rotary pumps, operating through a vertical cylindrical receiver; discharging of the slime residue is effected by 8-in. high-pressure pumps.

The main pump-building houses all the pump equipment, which is electrically driven. The list of pumps is as follows: three 12 by 15-in. for vacuum; two 11-in. diam. for mill-water; two 6-in. diam. for sand; two 6-in. diam. for slime; two 4-in. diam. for gland-water; two 4-in. diam. for gland-solution; two 3-in. diam. for permanganate; five 6-in. diam. for solution. There are also the following pumps for the filter-plant: two 3-in. diam., valve pressure; two 12-in. diam., slime and solution; two 8-in. diam., high-pressure wash-out; two 8-in. diam., air-vacuum; two 8-in. diam., solution-vacuum; one 6-in. diam., slime-residue; and two air-compressors. The control arrangements for the filter-plant and the whole pumping system, as well as telephonic arrangements, are thus in this one building.

The extractor house possesses no unusual features, the solution passing from constant-head tanks to ten mild-steel boxes, 5 by 39 ft., in which solutions are interchangeable.

The interesting features from the metallurgical standpoint are:

1. Thorough washing and elimination of fine before sorting.
2. Gravity flow from stamps to tube-mills.
3. New design of tube-mill.
4. Isolation without decentralization of plate-house.
5. Continuous slime-thickening by Dorr system.
6. Separation of sand and slime at a low elevation.
7. Flexibility of method of slime-treatment.
8. Collection and treatment of sand in one tank.

THE output of diamonds in the Union of South Africa, during the period from July to December, 1919, amounted to 1,383,860 carats, valued at \$34,724,263. October was the most productive month, 264,815 carats, worth \$7,529,147, having been obtained.

Metallurgical Results, New Modderfontein Gold Mining Co., (East Plant)

(June to November, inclusive, 1919)

	Total tons treated	Mill-feed Dwt.	Sand Dwt.	Sand tailing Dwt.	Slime Dwt.	Slime tailing Dwt.	Combined tailing Dwt.	Extraction based upon mill-feed and tailing from cyanide plant %
1919								
June	37,520	10.448	4.759	0.408	3.024	0.173	0.264	97.43
July	36,310	10.162	4.271	0.360	2.705	0.153	0.232	97.74
August	31,760	10.485	3.873	0.352	2.655	0.155	0.242	97.63
September	33,200	10.558	4.682	0.360	2.893	0.147	0.239	97.72
October	37,550	11.049	4.937	0.404	2.832	0.149	0.262	97.61
November	33,800	10.824	5.250	0.483	2.970	0.157	0.293	97.33

The Bunker Hill Enterprise—X

Inner History of the Company: Its Personnel and Its Finance

By T. A. RICKARD

Through all its vicissitudes the mine has yielded a nearly uniform product. The assay-value of the ore has been as follows:

	Lead	Silver
	%	oz.
For 22 years	11.28	4.92
For next 5 years.....	10.06	3.88
For last 7 years.....	10.10	3.92

The Guggenheims made many efforts to get control of the mine. Among these may be mentioned the purchase of the Tacoma smelter, the fanciful salary they paid Mr. Hammond, the continuation of Mr. Bradley as president of the Tacoma smelter, and his appointment as manager of the Federal Mining & Smelting Co., as well as direct negotiations for purchase of stock. When these efforts failed they resorted to apex litigation,† of a persistent and harrassing kind, over the Republican Fraction, San Carlos, and Viola claims, their suits being brought through Charles Sweeney, through the Empire State Company, and through the Federal Mining & Smelting Company over a period extending from June 1905 to March 1910. These attempts failed to undermine the title of the Bunker Hill company to its property and were discontinued after March 1910.

The apex litigation in which the Bunker Hill enterprise has been involved is worthy of special consideration. In giving an outline of the successive lawsuits I am indebted to learned counsel, Curtis H. Lindley, who has been the chief adviser to the company. By courtesy of Judge Lindley I am enabled to give a brief but comprehensive review of this phase of the Bunker Hill company's history.

The litigation extended over a long period of years, and involved a number of intricate mining problems, most of which were entirely new and were adjudged in these cases for the first time. The earliest case was what is known as the First Stemwinder, and in order to understand the problems involved in the ultimate ruling made by the courts of last resort, it will be necessary to review the legal decisions prior to that time in suits brought by the former owners of adjoining properties, as the decisions in these cases were of large import in the ensuing adjudications. The judicial status at the time the First Stemwinder suit was commenced may be illustrated by a diagram, Fig. 1.

It will be noted here that there was a small area in conflict between the Tyler and Last Chance, marked A on the diagram. At the time the Last Chance applied

for patent the Tyler company adversed as to this area in conflict, and in a suit to determine the question of priority the Tyler company withdrew its answer and abandoned its right to the ground in dispute, thus establishing, so far as those claims are concerned, conclusively the priority of the Last Chance over the Tyler. In a later suit the Tyler company claimed that the adjudication as to the priority of the Last Chance only applied to the surface, but did not affect the underground rights



cluded within the survey of the Last Chance. The Stemwinder contended that it was in fact prior in point of time to the Last Chance, and that its failure to adverse as to this small triangle only deprived it of the surface of the conflict area, and that it had the right to show its priority as against the Last Chance by evidence of the original locators. The trial court sustained this contention, and enabled the Stemwinder to prove its priority over the Last Chance by an hour and a half. The Circuit Court of Appeals, however, reversed this, holding that the failure by the Stemwinder to adverse the Last Chance operated as a conclusive adjudication as to all underground as well as surface rights. The

in favor of the King, but this was reversed by the Circuit Court of Appeals, whose opinion awarded what was then called a double-barreled extra-lateral right, that is to say, the Viola had the right to follow the vein in the direction of its end-lines, and the San Carlos had the same right, this extra-lateral right taking effect beyond the plane of conflict with the San Carlos extra-lateral right plane. The Supreme Court of the United States refused to review the case.

The next suit brought by the Bunker Hill company against the Empire State was known as the Second Stemwinder. The facts in this case may be illustrated by Fig. 4 and 5.



FIG. 2

Supreme Court of the United States refused to issue a writ of review, and this stood as the law until the Supreme Court itself reversed the doctrine in what is known as the United States Mining Co. v. Lawson case, as will hereinafter be made clear.

The next suit was brought by the Bunker Hill company against the Empire State company. This is known as the King Extra-lateral suit, and the facts of it are illustrated by Fig. 3.

It will appear from this diagram that there was a triangular segment covering the top or apex of the vein which had been left open by reason of the positions of the Tyler, Viola, and San Carlos lines. The King located on the area covered by this triangle, in the form of a parallelogram, 1-2-3-4, Fig. 3, laying practically all of its lines over prior patented territory. It claimed an extra-lateral right on the downward course of the vein underneath the San Carlos, Likely, and Skookum claims belonging to the Empire State. It will be noticed that the lode is a broad vein bisected by the common side-line between the Viola and San Carlos, the end-lines of which extended in opposite directions. The contentions were made upon the part of the Bunker Hill, first, that in order to secure an extra-lateral right on a broad vein the entire apex must be found within the boundaries; second, if any extra-lateral right was to be conceded to either claim, there should be one right only, and that would be in the claim having priority; in other words, the Viola would have an extra-lateral right in the direction of the lines A-B and C-D, which were not in conflict with the King extra-lateral right, but the San Carlos would have no extra-lateral right. The trial court held

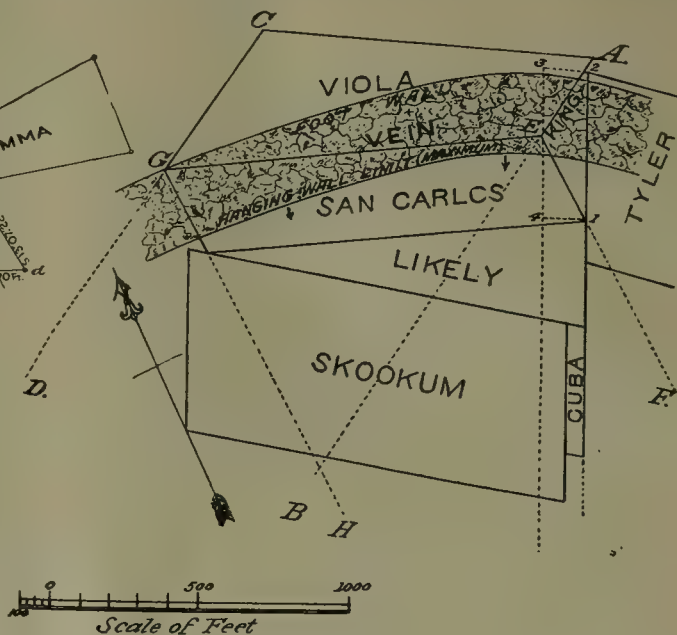


FIG. 3

It was contended on the part of the Stemwinder that although priority had been established in favor of the Last Chance and Emma, and it had been by the prior decisions compelled to recognize the extra-lateral right of these claims, notwithstanding this the Stemwinder extra-lateral right should be awarded to it on the downward course of the vein after passing the plane of conflict with the Last Chance and Emma. As the Last Chance was prior to the Viola and San Carlos, naturally it took the sweep of the vein within the extended extra-lateral right plane of the Stemwinder which in the previous controversy with the King had been awarded to the Viola and San Carlos. The situation presented on Fig. 5 is the net result, and established for the first time what is known as the 'jump over principle'; in other words, the extra-lateral right of a junior claim conflicting with the same right of a senior takes effect after passing the plane of conflict, and the courts intimated that it would have a right of way through for the purpose of following the vein. The result of these various decisions up to this point of time is shown in

the diagrammatic Fig. 6, carving up the segment of the vein as indicated by the conflicting extra-lateral right planes.

The next suit was known as the Bunker Hill Extra-lateral, and was brought by the Bunker Hill company against the Empire State. The Bunker Hill claim was the earliest located in that part of the country, and there was little difficulty in establishing its rights, so the court awarded the extra-lateral right in favor of the Bunker Hill as against all of the claims of the Empire State company.

The last suit between these two companies was based

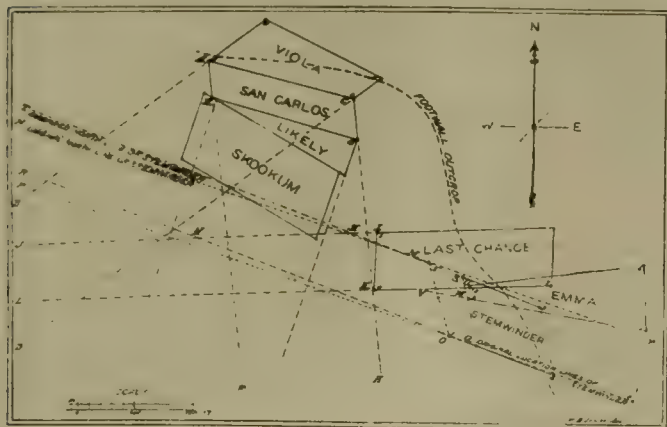


FIG. 4

upon the Viola and San Carlos, wherein it was sought to invoke the 'jump over' doctrine decided in the second Stemwinder case, as above noted. The extended end-line of these two claims, which are shown in Fig. 3, after passing through the extra-lateral right of the Bunker Hill claim, entered territory that was covered by other locations of the Bunker Hill company, but which were junior in point of time to the Viola and San Carlos, and raised some important questions of geological structure, continuity of orebodies, etc., which would have made it a long battle. This litigation, however, was compromised and the troubles between the two companies adjusted, by drawing vertical boundaries limiting the rights of the Empire State company or its successor, the Federal Mining & Smelting Co., underground, with the provision that after the ore contained in these boundaries should have been exhausted, all the property of the Empire State company or its successor, the Federal company, should pass to and become the property of the Bunker Hill company. It was a long time before the orebodies were exhausted, but ultimately they were, and the Bunker Hill succeeded to all the rights of its adjoining neighbor in the Wardner district.

All the novel principles adjudged in the foregoing cases have remained as precedents to this date, with the exception of the decision in the First Stemwinder case,

which held that a failure to adverse established priority conclusively in favor of a patent applicant both as to surface and underground rights.

In the United States Mining Co. v. Lawson case, 134 Federal, 769, decided in the Eighth Circuit, it was held that a failure to adverse was accompanied with no more serious consequence than the loss of surface conflict area, and that the party failing to adverse was not concluded in a subsequent suit involving underground rights from showing priority. This decision was affirmed by the Supreme Court of the United States in Lawson v. United States Mining Co., 207 U. S., page 1.

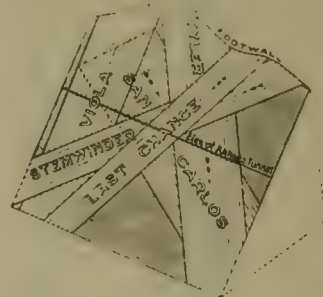


FIG. 6

The story of the movement of the different parties locating the Last Chance and the Stemwinder is of special interest. These two parties, the one known as the Flaherty gang, which located the Last Chance, and the other party, headed by S. R. Devine, who located the Stemwinder, approached the ridge on which the mines were situated from different gulches, and the locations

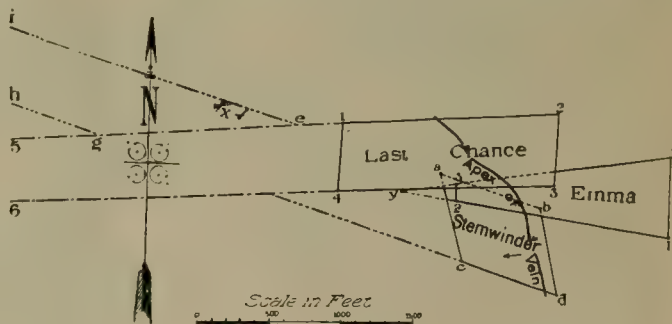


FIG. 5

of these claims by the two parties were in point of time very close together, the actual priority being found by Judge Beatty to be with the Stemwinder by about an hour and a half, after an intensive investigation of the history of the claims, which is referred to in the opinion, 108 Federal, page 189, et seq.

In the earlier days of the mine, particularly during the critical period of 1893, the management viewed the prospects in depth with considerable timidity. It was sug-

gested that winzes be sunk from the Bunker Hill No. 3 level to determine whether the ore continued downward, before incurring the expense of driving the Reed tunnel westward along the lode so as to connect with the Sweeney tunnel, of the Last Chance, which was then in good ore. This lack of confidence in the future of the Bunker Hill caused timidity in the financing of improvements and led to the resignation, as we have seen, of the president and manager of the company.

The map of the mine-workings shows that the ore is distributed in fairly defined bodies, the principal ore-shoot being the original or Bunker Hill shoot, which has its apex at the spot where the lode was discovered in 1885. This orebody has been followed for 3750 ft., on its pitch, which averages 37°. It has a maximum length of 1250 ft., on the 11th level. Eastward the Sullivan ore-shoot has been stoped downward to within 100 ft. from the Kellogg adit; it is irregular in shape, and has a maximum length of 1600 ft. on the 6th level. Some excellent ore has been struck in this part of the mine quite recently.

On the other side, westward, of the Bunker Hill ore-shoot comes that of the Stemwinder claim, the interval between them being 150 ft. They have the same pitch. The Stemwinder ore did not extend below the 600-ft. level, which is 500 ft. above the adit. Then come the Last Chance orebodies, which are regarded by some as a continuation from the Stemwinder, but this is open to doubt. The Stemwinder ore-shoot probably recurs in depth as an enlargement of the Bunker Hill ore-shoot; but it can hardly be considered as a portion of the Last Chance ore-shoot, which in depth is cut by the Cate fault, so that its lower portion should be thrown into the Sullivan ground. The Last Chance ore-bearing ground is 600 ft. long on the strike and reaches as far as the adit, which at that point is 1430 ft. below the surface.

Next is the Tyler ore-shoot. This may be regarded as a continuation of the Last Chance ore westward. It is 850 ft. long on the strike of the lode, and was worked down to the Sweeney level, which is 800 ft. below the outcrop. Thus it may be said that there is an almost continuous run of ore from the Sullivan claim to the Tyler claim, making 5100 ft., or, say, one mile long. Then comes a barren gap of about 1000 ft. before the old Sierra Nevada workings are reached. Here the lode dips south, as compared with the Bunker Hill's dip south-west; the ore is 1000 ft. long and extends for 260 ft. vertically—which is not much. Then, 800 ft. farther north-west, come the later workings in the Ontario and Stewart orebodies, which also dip south. Here the ore was 500 ft. long and was stoped for 400 ft. above the adit. The main Ontario and Stewart orebodies are outside and north-west of the Bunker Hill property, which covers 2920 acres of patented claims, or a length on the lode-channel of 26,000 ft., equal to about 5 miles, with a maximum width of 20,000 ft. or 3½ miles. The mine has 38½ miles of workings. The accompanying map and section show the distribution of the main workings.

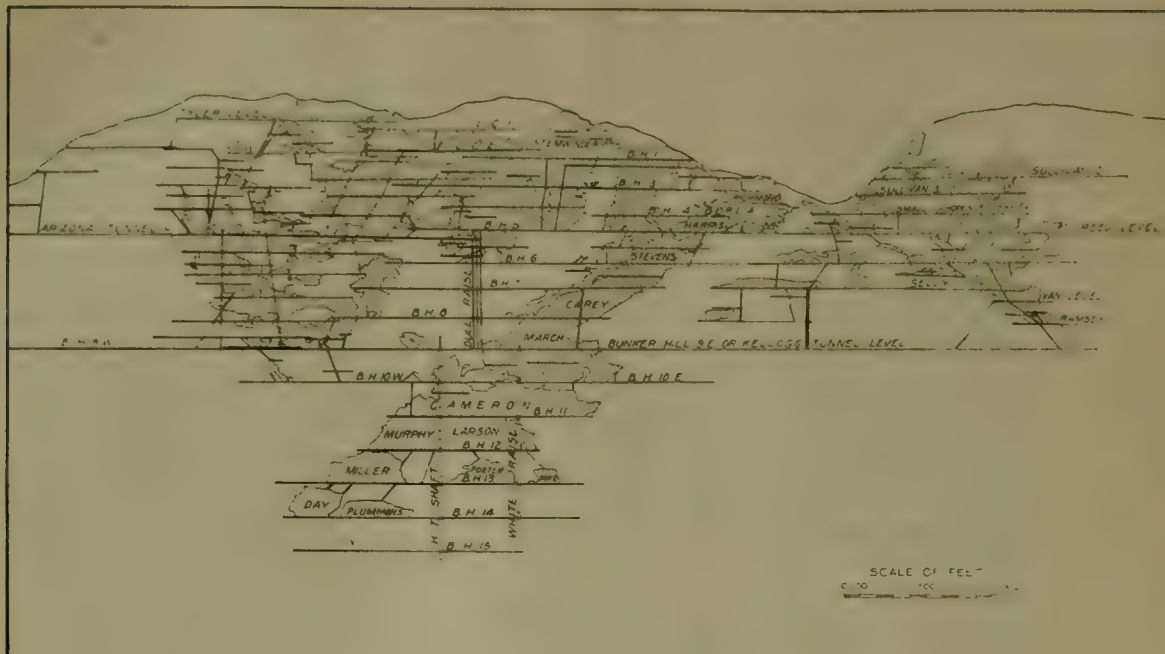
The average dimensions of the various ore-shoots, as estimated up to the year 1913, are as follows:

	Length Ft.	Width Ft.
Sullivan	600	18
Bunker Hill	600	35
Stemwinder	600	28
Last Chance	600	51
Tyler	356	14
Jersey	450	24
Francis	400	20

Expressed in terms of production, the output for the first 26 years aggregated 10,250 tons per vertical foot of mining. The average dimensions of the ore-shoots, however, give no idea of their irregular sizes and erratic shapes; looking forward, and deeper, they may pinch in size and they may be cut off by faults, but as against these contingencies there are many other and smaller ore-shoots in various parts of the mine that may increase in size, just as there are dislocated portions of known orebodies to be found beyond the faults already traced through the workings.

The Ontario claim deserves special mention. It became the property of Jonathan Bourne, Jr., of Portland, Oregon, in 1887, on the recommendation of Joshua E. Clayton. Bourne was a plunger; he bought the claim because Clayton (who was called 'Professor' in those days) dreamed that it covered an orebody worth half a million dollars. Mr. Bourne had several chances to sell the Ontario, but he declined them, because he was obsessed with Clayton's idea of its value. In 1908 he decided to bring an apex suit against the Federal Mining & Smelting Co. The Cate fault was then considered to be the foot-wall of the Bunker Hill lode-channel; near this fault no ore whatever had been found in the Ontario or its vicinity up to that time. Bourne demonstrated that the fault crossed the southern side-line of the Ontario and he nearly succeeded in proving that it crossed the westerly end-line, through the north-western corner of the claim; but the Federal company dug away this north-western corner and satisfied the Court that the fault left the Ontario claim through its northern side-line. Thus while Bourne lost his apex fight against the Federal company he contributed to a knowledge of the local geology, so that when F. Augustus Heinze appeared on the scene later and in 1910 uncovered a handsome orebody in the Stewart ground, just north of the Ontario, he (Bourne) was in a position to utilize the information obtained during his litigation with the Federal people. This he proceeded to do, and so successfully that the Ontario eventually yielded a profit of \$1,000,000, from ground within its vertical boundaries that was mined on a faulted portion of the Stewart orebody. Heinze fought hard to prevent the owners of the Ontario from mining this faulted portion of the Stewart orebody, but he lost. So Mr. Jonathan Bourne, Jr., realized Professor Clayton's dream after an interval of 25 years, by which time the Professor himself had gone to the land of shadows.

Looking over the graphic record of the enterprise it will be noted that the dividends soared abnormally in 1906, owing to the sale of the company's 31.34% interest in the Tacoma smelter, which was sold to the Ameri-



can Smelters Securities Co. in 1906, for \$5,079,438.80. The operating profit has varied considerably owing to the fluctuations in the market value of the ore. The tonnage has increased steadily, but the smelter returns have been affected directly by the ups and downs of the metal market. What these have been is shown in the statistics for lead and silver. The cost of concentration has increased, especially in later years, on account of higher wages and more expensive supplies, particularly machinery and machine parts. The increase in dividends is attributable to the combined effects of an increased output, better smelting-rates, a higher price for the metals, together with the additional profit from other sources. The high peak in operating profit in 1917 is linked with the starting up of the Bunker Hill smelter and the abnormal price of lead, due to the War. The wide difference between profit and dividends in 1917 and 1918 was caused by the cost of building the smelter, for which \$2,850,000 has been diverted from current earnings, as well as \$950,000 additional for stocks of custom smelting-ores. How the prices of lead and silver have fluctuated is shown herewith:

Prices of Lead and Silver

	Lead Cents per lb.	Silver Cents per oz.
1888	4.42	94.00
1890	4.48	104.60
1895	3.23	65.28
1900	4.37	61.41
1905	4.707	60.35
1910	4.446	53.48
1915	4.673	49.68
1916	6.858	65.661
*1917	8.787	81.417
1918	7.413	96.772
†1919	5.759	111.22

*In June 11.17c. †In December 131.97c.

The relations between the Bunker Hill and various smelting companies are worthy of record. The first concentrate, produced in the mill that was built in Milo gulch, was shipped to the smelter, at Wickes, Montana, under contract of 1888 with the Helena & Livingstone Smelting & Refining Co. The next contract was made with Anton Eilers, of the Colorado Smelting Co., at Pueblo. Later the output of the mine went to the various smelters at Denver, Pueblo, Kansas City, Omaha, and San Francisco. In 1898 the Bunker Hill company joined with the Alaska Treadwell group (of which Mr. Bradley was president and D. O. Mills a large shareholder, as of the Bunker Hill) in buying 1567 shares out of a total of 5000 shares in the company owning the smelter at Tacoma, on the shore of Puget sound. This stock was bought at the rate of \$100 per share and gave the Bunker Hill a holding of 31.34%; the Alaska Treadwell companies bought an equal interest; certain other friendly individuals also purchased stock, the remaining shares representing the personal holdings of W. R. Rust (the manager of the plant) and a few old stockholders. The smelter was in a dilapidated condition and needed to be reconstructed. The proceeds of the stock-sales went into the treasury of the re-organized company, of which

Mr. Bradley became president, while Mr. Rust continued in charge as manager. Having now an assured supply of lead concentrate from the Bunker Hill mines and an assured supply of gold-iron concentrate from the Alaska Treadwell mines, this smelter was soon placed upon its feet and became such a profitable business that it not only paid dividends after completely rehabilitating its lead-smelting department, but it was enabled, out of its earnings, to add a copper-smelting department. This, the first copper refinery on the Pacific Coast, started to work in 1903. In consequence of its success, the smelter was coveted by the Guggenheims. In 1904 they sent H. C. Davis to Tacoma and he took Mr. Rust back with him to New York. Through Mr. Rust they secured the written consent of Mr. Mills to a sale of the Bunker Hill interest. Early in 1905 Messrs. Davis and Rust, accompanied by Bernard M. Baruch, came to San Francisco in order to complete negotiations. This required several months and resulted in a payment of \$1015.89 per share or a total of \$5,079,438.80 for all the stock of the Tacoma Smelting Co. At the same time, the Guggenheims (in the name of the American Smelters Securities Company) bought control of the Selby smelter at a price of \$4,224,000. The Tacoma and Selby smelting companies were mutually dependent to the extent that the Tacoma lead bullion was being refined at the Selby plant; this inter-dependence was used by the negotiators as a means of scaring each smelting company into the belief that the other had sold out. Two years earlier the Guggenheims had acquired the Everett smelter.

One condition in the sale of the Tacoma smelter was that 25-year contracts be made with the American Smelting & Refining Co. for the concentrates produced by the Bunker Hill and the Alaska Treadwell mills, with the proviso that the contracts be revised after the first five years to meet whatever competition might then dictate. Previous to the expiration of the five years, the Alaskan companies created their own competition by building the first unit of a cyanide plant. The A. S. & R. company could not meet the rates as determined by this cyanide mill and consequently lost the Alaskan output. In the case of the Bunker Hill, this company had bettered its contract even before the expiration of the five-year period by establishing outside markets for its + 75% lead and its - 30% lead products, which the Guggenheims, by an oversight, had excluded from the 25-year contract by covering only such of the Bunker Hill products as assayed between 30% and 75% lead. The concession that had been won as to the + 75% product led to investigations in search of a wet process capable of turning out metallic lead and zinc, and this research is still proceeding. It is interesting to note that not only did Curtis H. Lindley and Myron A. Folsom, as counsel, decide that the building of a smelter by the Bunker Hill company was no infraction of the contract with the American Smelting & Refining Co., but Peter F. Dunne, attorney for W. H. Crocker, concurred. Nevertheless it caused litigation. After the concessions won in 1910 there followed a tightening of the Guggenheim smelting control

and the gradual spoiling of the Bunker Hill's market for its — 75% and — 30% products, in which categories the company was preparing to place the whole of its output. After 1912 the Tacoma company ceased to operate its lead plant, the Bunker Hill output being diverted to the Selby and East Helena plants of the A. S. & R. Co. The dispute with the smelter trust led to the building of a smelter of its own by the Bunker Hill company at the mine. This plant began operations in July 1917, whereupon the A. S. & R. Co. brought suit, the first hearing being set for October 18 at Portland,* in order to obtain a preliminary and permanent injunction against the operation of the smelter at Kellogg. This it failed to do. Eventually, in 1918, this litigation was compromised by cutting the Bunker Hill production in half, one portion to go to the company's own smelter and the other portion to the A. S. & R. Co.'s smelters for the remaining 12 years of the 25-year contract at much better rates than any theretofore obtained.

Rates for freight and smelting on concentrate at various periods during the life of the mine may be compared as follows:

Year	Smelter	Freight and treatment per ton
1886	Helena (Montana)	\$38
1891	Globe (Denver)	28
1894	" "	24
1897	" "	18
1900	Selby (San Francisco)	17
1905	Tacoma (Washington)	16
1908	Pennsylvania (Colorado)	19
1913	International (Utah)	15
1918	A. S. & R.	15

Another interesting phase in the history of such a mining enterprise as the Bunker Hill is the cost of equipment, plant, and other betterments during the entire period under review. Twelve years ago I drew attention† to the fact that, as stated in Mr. Bradley's special report of May 27, 1908, to the shareholders of the company, the cost of betterments during 22 years had averaged 80 cents per ton, ranging from a minimum of 43 cents to a maximum of \$3.40 per ton. At that time it was anticipated that an allowance of 30 cents per ton for betterments would suffice for the future. For the 33 years to December 31 last, the following figures are available:

Operating profit	\$30,627,610.26
Profit from other sources	4,213,606.32
	<hr/>
	\$34,841,216.58
Dividends paid	\$23,231,250.00
Cash and bonds on hand ..	2,383,933.14
	<hr/>
	25,615,183.14
Leaving	\$ 9,226,033.44
This sum of over nine million dollars represents the	

cost of equipment, additional mining property, litigation, etc., besides the bare operating costs, or \$1.05 per ton for all expenditures of every kind, in addition to operating freight, smelting, and selling costs. Another tabulation will show the importance of an item usually overlooked when starting a new mining enterprise.

	First 22 years of the property up to May 1, 1908	33 years of the property up to Dec. 31, last
Total tons of ore mined ..	2,591,880	8,756,536
Gross value of the ore ..	\$11.060 per ton	\$10.44 per ton
Other income	0.509 " "	0.48 " "
Total to account for ..	\$11.569 " "	\$10.92 " "
Operating costs	\$2.665 per ton	\$2.64 per ton
Freight and treatment ..	5.160 " "	4.31 " "
Dividends and cash	2.944 " "	2.92 " "
Betterments and additional mining property ..	0.800 " "	1.05 " "
Total	\$11.569 " "	\$10.92 " "

During the entire life of the mine, the gross value of the ore recovered has been used up as follows:

	%
Operating cost	25.30
Freight and treatment	41.21
Dividends and cash	28.01
Betterments and additional mining property	5.48
Total	100.00

The 5.48% for betterments and additional mining property, in this last tabulation, is a forced balance to make 100%; but it can be considered as a portion of the cost of these items, the remaining portion of the cost of which can be considered as having absorbed other income, or the profits earned from sources other than from the gross value of the ore. These other sources have been dividends from subsidiary mining companies, for example. Thus while the cost of betterments was 80 cents during the first 22 years, it averaged \$1.05 during the entire 33 years, but this includes the \$2,850,000 diverted from current earnings to build the smelter, plus \$950,000 diverted for the purchase of custom ores, making a total of \$3,800,000, accounting thus for 43 cents out of the \$1.05 per ton, which is reduced thereby to 62 cents per ton.

Mr. Bradley's presidency of the company has synchronized with the period of its successful development. He obtained his technical training at the University of California in 1882 and the two following years, but he did not graduate. Like many men now conspicuously useful and successful he worked his way through college, that is, he met the expense of his education by working during both the college course and holidays. Shortly after leaving the University he made a name for himself by establishing a record for low cost in mining. This was at the Spanish mine, in Nevada county, California. The issue of the 'Mining and Scientific Press' for October 22, 1887, published the following figures. In 22 days of September, 2796 tons of ore was mined at a cost of 37½ cents per ton, of which 32.4c. was for labor and 5.1c. for

*See 'M. & S. P.' editorial, 'American Smelting v. Bunker Hill'; December 1, 1917. Also abstracts of affidavits by Edgar L. Newhouse and F. W. Bradley in same and succeeding issues.

†'Variations in Mining Costs', by T. A. R., 'M. & S. P.', July 4, 1908.

supplies. The mill treated this ore in 20 days at a cost of 23 cents per ton, of which 12.3c. was for labor and 10.7c. for supplies. Thus the total operating cost was 60½ cents per ton; the ore yielded \$1.155 in gold per ton, leaving a profit of 55 cents per ton, or 48% of the yield. The milling was done with four Huntington mills and amalgamating plates; the ore was quarried from a hillside, and the labor was performed by Chinese labor at \$1.40 per shift. Mr. Bradley was working the mine under lease after the management had been embarrassed by local debts. The conditions were unusually favorable as to softness of the ore, accessibility, metallurgic simplicity, and cheap labor, but even at that the results were so remarkable as to attract general attention, which, as might be expected, was magnified by the manufacturers of the Huntington mill (the firm of Park & Lacy, in San Francisco). The record made at the Spanish mine was noted in all the books on gold mining of that time. Mr. Hammond heard of the good work done by this young man in the Californian foothills and offered him an engineering appointment at the Bunker Hill in September 1890, and shortly afterward, on Mr. Webb's resignation, made him assistant manager. Mr. Easton graduated from the University of California in 1894. Immediately afterward he worked as a miner in the Bunker Hill mine for several months, obtaining thereby a first-hand knowledge of underground operations. Subsequently he had charge of small mines in British Columbia and Colorado, and in 1902 he was assistant to Mr. Bradley in his San Francisco office. Thus he was well prepared for the responsibilities of manager when in July 1902, upon Mr. Burch's resignation, he was appointed thereto by Mr. Bradley. To the cordial and intelligent co-operation between these two engineers the success of the Bunker Hill enterprise owes much, although both of them are inclined to give the credit to the mine itself.

On the accompanying pages will be found photographs of the principal characters in this interesting story of mining enterprise. R. S. Handy, superintendent of the mills, came from Colorado; he spent one year as a special student in the University of California; in 1905 he entered the employ of the Bunker Hill company as its representative at the Tacoma smelter and in 1906 was transferred to Kellogg, where in 1907 he took up testing and experimental work at the concentrator. In January 1910 he was promoted to the superintendency of all the milling operations.

Walter C. Clark, electrical engineer for the Bunker Hill company, was born in New York and started his career in a drug-store at Eureka, Utah; he was early attracted by electrical engineering; in 1895 he operated the electric-light plant of Eureka; in 1898 he was invited by Mr. Burch to come to the Bunker Hill, where he has remained ever since, rising to positions of increasing responsibility.

Gelasio Caetani worked underground and in the mill soon after graduation from the Columbia School of Mines, and finally designed a new mill for the Bunker Hill company. He is a native of Italy and the scion of a noble house, being the son of the Duke of Sermoneta.

Only his closest friends were aware of this fact; he made his own way by sheer force of character and mind. Just before the War he was in partnership with Messrs. Burch and Hershey in San Francisco; when the call came he hastened to Italy and joined the engineer corps of the Italian army, serving with great distinction, and being the hero of the Col di Lana affair on April 17, 1916, on which occasion, as captain of a detachment, he drove a drift 300 ft. long under the Austrians, who were counter-mining; he succeeded in exploding five tons of gelatine and nitro-glycerine under the Austrian position, thereby lifting 15,000 tons of rock and killing 80 of the enemy, besides capturing the 179 survivors, including 9 officers. For this he was decorated. Later he served as a military attaché to the Italian mission at the Paris conference. Talk of romance! the true story of Florence Smith on the one hand and of Don Gelasio Caetani on the other shames the silly yarn about the burro and the prospectors. Truth is stranger than fiction, after all, and far more poetic!

GEOLOGY constantly is being given added recognition as an important factor in the development of oil. The immense growth in the world demand for petroleum and its products is taxing to the uttermost the capacity of the known oil-fields and stimulating the search for new ones. The study of the producing fields is being carried on more and more intensively, not only to learn what contributions may be expected from such new fields as may be found but to maintain the declining production of the old fields and to squeeze the last profitable drop from them. The work of finding petroleum and of producing it is becoming less and less 'a gamble' and more and more an exact science. Geologic work is not only essential to the discovery of new fields but can be profitably continued to direct exploration and production in old fields. For the lack of geologic work different producing beds reached by different wells have been confused during the early life of a field, and the possible sources of water trouble have been overlooked. Men who might have been millionaires have been made practically penniless because they abandoned a well too soon through ignorance or misconception of the true number and position of the oil-bearing beds, and companies well on the road to success have suffered serious reverses by useless expenditure incurred in drilling wells where there was practically no chance of striking oil, and by deepening holes that had already passed through all the possible oil-bearing beds. Entire fields have been abandoned, or almost abandoned, only to be re-opened when applied science or random drilling revealed the existence of oil-sands below the old 'pay'. Other fields have been lost through water trouble due to carelessness, lack of experience, or ignorance of the true source of the trouble and how to prevent it.

SALVADOR is rich in minerals, having deposits of gold, silver, copper, iron, lead, zinc, and antimony. Gold constitutes one of the principal exports. A Canadian company is exploiting the chief gold mines in the country.



FREDERICK W. BRADLEY (U. C. '86)



STANLY A. EASTON (U. C. '94)



VICTOR CLEMENT



MRS. SIDNEY CROMAN



GELASIO CAETANI



ALBERT BURCH



R. S. HANDY, MILL SUPERINTENDENT



W. C. CLARK, ELECTRICIAN



KELLOGG, IDAHO



THE OLD PLANT ON THE CORTEZ PROPERTY

The Cortez Mine To Be Re-Opened

Special Correspondence

A company composed of mining men from New York and Nevada has been organized to re-open and develop the old Cortez mine, known also as the Wenban mine, situated on the boundary between Lander and Eureka counties, 35 miles south of Beowawe, a station on the main line of the Southern Pacific railroad. The tunnels, through which the mine was worked, are on the south slope of Tenabo peak, in the Cortez range. The mine has produced ore valued variously at from \$13,000,000 to \$19,000,000. The first locations were made in 1863 by Simeon Wenban, who had been grub-staked by Senator George Hearst. Rich float, shown him by Mexican prospectors, led Wenban to the outcrop on the St. Louis group, high on the south side of Tenabo peak. Subsequently he located the 'Arctic', 'Fitzgerald', and 'Gar-

rison' claims and incorporated them in the Tenabo Mill & Mines Co. Ore was hauled to Austin, 65 miles distant, until in 1867 Wenban bought a small mill, with roasters and silver-pans, in Mill canyon, six miles from the mine.

In 1886 he built a 50-ton mill at Cortez, a mile below the mine. The treatment included grinding, heating, wetting, roasting in rotary kilns with salt, sulphur, and lime; and then leaching and smelting with charcoal, at a total cost of \$28 per ton. Lime was produced in local kilns and brick (for building and furnaces) was made at the mine. Mexicans, using as many as 600 pack-animals, supplied charcoal and nut-pine wood for the furnaces, while a 16-mule team was continually engaged in hauling salt, shipped to Beowawe from the Great Salt Lake. An O'Hara furnace was built at a cost of \$50,000, but was



THE MILL AND ROASTER

found to be useless and was abandoned after a few days. A narrow-gauge railroad, with wood-fired locomotive, connected the mine with the mill. Water was brought seven miles through a two-inch pipe-line, still in good repair. For three years, from August 1888, the mine was worked under lease by Bewick, Moreing & Co., of London. During this period the ore averaged 51 oz. silver and \$3 gold, and in three years with silver selling at 86c. dividends amounting to \$671,577 were declared. The main tunnel is in limestone that underlies a wide bed of quartzite. The latter dips 20° north-east and is overlain by another lime stratum. A wide fissure, nearly vertical, cuts but does not displace these strata. The best ore is found in secondary fractures, in the limestone, and in smaller chambers in the quartzite. The main tunnel, nearly 4000 ft. long, follows this vein for a considerable distance and connects with two shafts. Stopes in the limestone are flat and dip with the quartzite, and pillars of rich ore still remain. Visible ore, including dumps and stope-filling, is estimated at 68,695 tons.

A dump containing 5000 tons at the Fitzgerald mine sampled more than 25 oz. silver. Tailing dumps contain 120,000 tons, of which 80,000 tons already has been re-treated with a yield of 10 to 14 oz. of silver. This was ground to 20 mesh only, and will be treated again. The Arctic tunnel, driven from a gulch east of, and 300 ft. below, the main tunnel, was advanced 1600 ft. and is to be extended 600 ft. farther to cut the quartzite contact. Fractured ground east of the lower tunnel also will be explored. The ore in some parts of the mine contains lead with not more than 0.5% copper and a little zinc. An operating organization has been perfected and equipment will be provided to drive the lower tunnel and to handle ore and waste from the main-tunnel workings.

THE Mukden district of South Manchuria is generally credited with remarkable resources of minerals, but the present developments are of a limited character. Deposits of coal, iron, gold, silver, copper, lead, asbestos, magnesite, soapstone, and antimony have been reported. Coal is already being extensively mined both by Japanese and Chinese. The former are working large deposits with modern machinery, while the latter are still using crude native methods. The Chinese are planning, however, to obtain modern mining equipment and there will soon be a considerable demand for American machinery. The Japanese are developing large deposits of iron ore. It is estimated that one of their concessions will be capable of supplying ore to their new steel works at a yearly rate of over 1,000,000 tons of ore for 60 to 100 years. The gold is obtained only by placer mining and is not produced in large quantities as yet, although it may be possible to mine on a large scale by improved methods. The magnesite deposits are said to be equal in quality and quantity to any in the world and considerable development along this line is expected, as the world's supply of magnesite is limited and its use is rapidly increasing. Silver, copper, lead, and antimony are not mined in large quantities, and it is doubtful if they are abundant.

Metal-Mine Accounting

Mine accounting including the keeping of costs in mining, milling, and smelting operations has been dealt with often, but mostly with regard to forms for cost sheets, payrolls, time-cards, warehouse requisitions, and other plant forms, without any explanation of book-keeping methods necessary for their compilation, says C. B. Holmes in Technical Paper 250, U. S. Bureau of Mines. He offers the following interesting advice to those who may be starting the development of a new property.

While the articles of incorporation are being prepared or a month before you are ready to start construction, you should employ four persons; first, a practical bookkeeper; second, an experienced warehouse-man; third, a timekeeper; and fourth, a carpenter foreman. Explain to the bookkeeper what the nature of the plant and operation is to be and let him get up a set of books and forms to cover the needs of the plant. Decide on about how much you want to spend on an office building and warehouse, and if your warehouse-man is experienced get his idea as to how the warehouse should be constructed. While the carpenter foreman and his men are building an office and warehouse you will have time to look around for a superintendent or foreman.

To the bookkeeper: after you have found out what the construction and operation program is to be and have formulated a set of books to cover, take the timekeeper and warehouse-man into your confidence and teach them the accounts to which labor and material are to be charged. The accuracy of your books and reports depends solely upon them. You will not have time to follow the timekeeper around and see that he is correctly charging labor, or to see that all withdrawals from the warehouse are properly charged.

This advice is for the engineer in charge: if it has been left to you to decide what detailed costs of construction are to be kept, use a little judgment and do not make the costs so complicated that the whole force will have to be expert accountants in order to properly distribute their time or charge material drawn from the warehouse. I have seen cost schedules devised whereby a carpenter would have to charge his time to one account if he was driving nails into a floor and to another if he drove nails into the wall alongside of him. By following this procedure the construction, development, mining, and other costs will reflect the actual amount of labor and material expended and not contain items prorated from a material shortage discovered after a few months, as is the practice with most mining ventures. During the period of construction and preliminary development the overhead expense can be distributed on the basis of the percentage it bears to the direct expense (labor and material), but after the plant has started operating costs should not be 'fooled' by charging every little item of further construction and changes around the plant with a portion of the overhead expense, as this would probably amount to the same if there were no construction work.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

U. V. X. SELLS ITS EXCESS COPPER.

BISBEE.—Operations at the A. B. C. mine, which has been shut down for a month, have been resumed. Drifting toward the Abrigo fault on the 400-ft. level will be the principal work done. Some work will also be done on the 500 and 600-ft. levels. It is also planned to start a tunnel on the R. A. M. group of claims to explore the Ladie claim.

The Great Western Copper Co., at Courtland, is employing 35 men and shipping about 60 tons of sulphide ore per day, and the Leadville No. 1, at the same place, is shipping regularly to Douglas.

The underground workings of the Commonwealth mine at Pierce is being operated by lessees. About $4\frac{1}{2}$ tons of high-grade silver ore said to average 2200 oz. per ton in silver was recently taken out.

The Keystone Copper Co., at Johnson, now has the machinery on the ground for the new 100-ton mill. Construction is to commence as soon as the lumber can be obtained. The Johnson mine has resumed operations and is employing about 65 men. The Johnson Development Co.'s mine is being unwatered after a shut-down of one year.

CLIFTON.—G. J. Stoneinan, president of the Stargo Mines Co., announces that the second payment to the owners of the Stargo property will be made about June 1. The Stargo Mines Co. has been developing shipping ore for the past year. The mill-site is being surveyed by the General Engineering Co., of Salt Lake City, preparatory to the erection of a concentrator and cyanide mill. The Stargo are assays \$15 to \$20 per ton in gold and silver.

JEROME.—It is reported that the United Verde Extension Mining Co. has been selling its copper on hand as fast as possible so that only 7,000,000 lb. remain to be disposed of, as against 27,000,000 lb. at the first of the year. In spite of the low prices a good profit has been realized, as the cost of production was less than 10c. per pound.

KINGMAN.—It is reported that the shaft of the Mollie Gibson-Chloride mine has reached the 100-ft. level, where a two-foot vein of galena ore was cut. It is announced by E. A. Ritter, consulting engineer to the Arizona Mossback Mines Co., that the board of directors has agreed to raise \$500,000 by a bond issue for the development and equipment of the mine and the erection of a mill. While cutting a station at the 300-ft. level of the I. X. L. mine

a large body of high-grade mill ore was opened up. It is the intention of the management to cross-cut the vein at the 700-ft. level and drift both ways.

PRESCOTT.—The Golden Dragon Mining & Milling Co., which controls the Emporia group of claims, has acquired the Briganza group on the same ore-zone. A 180-ft. shaft has been sunk and 400 ft. of drifting has been done on the Briganza property. J. Gardner Scott, president of the company, announces that the ground lying between the workings of the two groups of claims is to be prospected immediately. The present five-stamp mill



500-TON FLOTATION-TEST PLANT OF THE NEW CORNELIA COMPANY AT AJO

on the Emporia property is to be fitted up for testing purposes.

TUCSON.—Los Angeles interests have purchased the holdings of Messrs. Atchley and Hoff in the Arizona Tucson Copper Co. The shaft has been sunk to the 135-ft. level. Twenty feet of rhyolite has been passed through which is stained with iron and contains a small amount of native copper. The company now plans to sink to the 400-ft. level and do lateral development at 100-ft. intervals.

John C. Greenway, general manager of the Calumet & Arizona Copper Co., has announced the purchase of the 85 mine in the Virginia district near Lordsburg, New Mexico, by the Calumet & Arizona. The property has been acquired primarily to obtain silica for the Douglas smelter, but the ore contains some copper and silver. This mine has produced several million dollars worth of ore and it is estimated has half a million tons of low-grade ore developed.

COLORADO

COMPANIES PROVIDE TRANSPORTATION AT CRIPPLE CREEK.

CRIPPLE CREEK.—Mining companies will provide transportation to and from the mines, to employees, now that the electric-car line and Short Line steam-road have ceased operating. The Cresson company has provided a special train over the Midland Terminal road for the men on night shift, and it is understood that the Midland company will announce additional suburban service as soon as time-tables are prepared. A miners train, leaving Cripple Creek at 6:50 a.m., is packed to capacity. The Lincoln Mines & Reduction Co. provides auto transportation to and from its Ironclad Hill mine and mill without charge. The Morrell Hardware Co. is running its big auto-truck to Ironclad Hill for the accommodation of miners employed at the Jerry Johnson, Forest Queen, and other mines, without charge, and mine superintendents owning autos are also taking their men to the several properties. In addition to this free transportation, mining companies have announced a 'horizontal' wage-increase for all employees of 50 cents per day.

An electric hoist has been placed at the 900-ft. level of the Empire State shaft, Isabella Mines Co., to be used when sinking of the shaft is started. Six sets of lessees on the property are producing and shipping a good grade of ore from the upper levels. Lessees on the Johnson shaft, Dante Gold Mining Co., have opened up a strong body of one-ounce ore and have commenced shipments to the Golden Cycle mill.

The Lincoln Mines & Reduction Co., it is officially announced, will start concentration of ore at its plant on Ironclad Hill about July 1, when the plant of 400 tons capacity will be completed. The initial treatment will be one hundred tons daily.

OURAY.—Lessees on the Wedge property in the Bachelor district below Ouray are shipping high-grade ore to the smelter from a rich new orebody recently opened. Samples assaying 500 oz. silver are reported from the recent discovery on the El Mahdi, by a leasing company of local men. The vein, five feet wide, is all of shipping grade with richer ore found in two feet next to the hanging wall. In the Lake City section an ore-shoot is reported developed for 400 ft. that is 10 in. to 3 ft. wide, on the Fanny Fern. Shipments packed out and shipped to the smelter have returned from \$60 to \$350 per ton. A pack-train got through the melting snow to the property of the Goleonda Mining Co. last week, and operations have been resumed for the season.

LEADVILLE.—The south-western portion of the Leadville district, known as the Silver section, will receive unprecedented exploration this summer. In this territory a number of lessees are already operating and shipping ore is exposed in many old mines that have been idle for several years. In Colorado gulch, claims surrounding the Gertrude are receiving special attention through the opening of rich silver veins during the winter months by the Gertrude lessees. With roads opened, more than 50 tons of high-grade silver ore, stored at the mine in sacks, will be hauled down to the smelter. The main vein under

development at the 120-ft. level of the Gertrude is $3\frac{1}{2}$ ft. wide and assays have shown a silver content of 252 oz. with $2\frac{1}{2}$ oz. gold and 41% lead. North of the Gertrude the Venture, Golden Curry, and Tiger properties, former silver producers, are again active. To the north-west in Little Frying Pan gulch, John Cortellini and associates have operated all the winter in the Keystone tunnel. East and north of Colorado gulch the Dinero and Bartlett tunnels have been operated by lessees this past winter and ore of good shipping grade has been mined in the Dinero. Development on ground cut by the Bartlett tunnel is reported to have been encouraging.

MICHIGAN

WINONA SUSPENDS OPERATIONS.

HOUGHTON.—Fire in the engine-house at No. 3 Kearsarge will interfere to some extent with the production from this branch of the Osceola Consolidated during May. The engine-house was completely 'gutted' and it will be weeks before it will be fit for use. No. 3 shaft is producing the best grade of ore that is coming out of the North Kearsarge. Drifting in progress at the bottom level, the 35th, shows good ground. Power-haulage is in use on the 31st and 32nd levels.

Winona suspended mining operations on May 15. This looks like the finale. The orders from the eastern office not only ordered the suspension, but instructions are to the effect that everything must be taken from the mine that has value. The mine will, therefore, fill with water. If at some later date it is deemed advisable to open the property again the outlay necessarily will be large. From a mining standpoint the decision is regrettable, for at the present time the openings are really in better quality of 'rock' than ever before. The reason for suspension is simply inability to secure the necessary labor to get production large enough to meet the overhead. Winona at best is a low-grade proposition. It does not carry the mass and barrel-copper which has preserved other smaller Ontonagon properties. The history of the Winona has been one of constant hope, large outlay, many millions spent in development, and failure to achieve the desired result. Altogether six shafts were opened and the deepest is 1500 feet. The exploration work has been in the opening of laterals, rather than at depth. Numerous assessments and no dividends are recorded.

Quincy's production of copper for the month of May will not show any increase in total tonnage, yet it will yield between 20 and 21 lb. per ton. This is the best showing the Quincy has made in years. It particularly is gratifying because of the fact that the tonnage mined is below normal. The betterment in the Quincy yield is due more particularly to the improvements which have been made at the stamp-mill, rather than in any change in the situation at the mine or any improvement in the underground conditions. The improvements in the mill, by way of re-grinding appliances, have not been completed, but the saving to the shareholders of the Quincy corporation by reason of these mill changes is substantial.

MONTANA

LABOR SHORTAGE AT BUTTE.

WICKES.—The Atlas mine is to be re-opened and work commenced. Present development consists of a 300-ft. shaft, 800 ft. of drifting on the three levels, and a 100-ft. connecting raise. A reserve of 40,000 tons of concentrating ore, averaging \$12.35 per ton, is estimated between the 100 and 300-ft. levels. Average assays from this ore show 3.2% copper, 12 oz. silver, and 80c. in gold per ton. The equipment includes a 30-ton concentrator and a hoist capable of operating to a depth of 500 ft. The old smelter slag-dumps amounting to 10,000 tons are being loaded for shipment to the East Helena smelter.

Plans for the construction of a 100-ton flotation plant at the Mt. Washington mine have been completed and construction work will commence at once. The mine is one of the largest silver producers in the district. A large tonnage of ore has already been blocked, assuring a good daily production as soon as construction work has been completed. Preliminary flotation tests indicate a high recovery.

HELENA.—The Lump Gulch district now has a number of steady shippers. The Liverpool mine is maintaining a big production of good ore. The Free Coinage is carrying on sinking operations together with keeping up its production. Development work at the Muskegon and Vera Cruz mines continues to be satisfactory.

NEIHART.—The Moulton mine at present is averaging 10 carloads of concentrate and crude ore per week. One car of high-grade ore now in transit is expected to net a return of \$16,000. The output for April has been such as to assure the provisional fifty-cent bonus promised to miners.

BUTTE.—Labor shortage has caused the Anaconda company to close down six of its mines, namely, the High Ore, Mountain Con., Mountain View, Pennsylvania, Belmont, and Tramway. North Butte produced 1,000,000 lb. of copper during April. Development on the 3400-ft. level in the vicinity of the rich Edith May vein is reported as favorable. Assays along the hanging-wall side show 10½% copper for several feet.

The Barnes-King Development Co. reports the following production records for April from its properties; North Moccasin, 1463 tons, bullion yield \$13,000; Piegan-Gloster, 1430 tons, bullion yield \$18,800; Shannon, 2283 tons, bullion yield \$13,800; total, \$45,600.

PHILPSBURG.—Production in this district is less than 50% normal, due to the tie-up in transportation and drop in the price of silver. The Philipsburg Mining Co. is employing 300 men, less than half of normal. Manganese concentrate is being shipped to Tacoma and San Francisco. The Morelight Mining Co., operating the Headlight and Whitehorse claims, is producing about 18 tons of manganese concentrate daily. Seventy-five men are employed. Since the price of silver went 'tobogganing', 50 of the 125 lessees working silver properties have abandoned their claims, as ore containing less than 25 oz. of silver per ton cannot be profitably mined.

NEVADA

SEVERAL NEW MILLS UNDER CONSTRUCTION.

LUCKY BOY.—A 100-ton concentrator is being built at the Lucky Boy to treat silver-lead ore. The Lucky Boy was found in 1907 and it has produced more than \$2,000,000, mainly from the work of lessees. The Lucky Boy Consolidated, controlled by Jesse Knight, of Utah, drove a 7000-ft. drainage tunnel, cut the vein at 1000 ft., and made connection with a 700-ft. lease shaft. After intermittent production the Consolidated stopped work in 1915 and the mine was again turned over to lessees. The company levied an assessment late last year and resumed work. The lessees shipped rich ore only, and there remains much low-grade material that can be treated at a profit in the new plant. The ore in the dumps is estimated to average \$20 per ton. A new shaft



WORK IN A MICHIGAN COPPER MINE

has been sunk 100 ft. and a cross-cut is being driven to the vein, which also is being opened by cross-cuts from a tunnel. Before work was resumed the claims were added to by the purchase of 20,000 acres, including the Hawthorne townsite. The vein extends into this ground, and before 1915 a drift was driven from the drainage tunnel to the boundary line of the original claims.

ELY.—The 100-ton cyanide plant of the Wyoming Mining & Milling Co. has been started and will be operating at capacity within three months, according to E. P. Bowman, general manager for the company. Eighteen thousand tons of ore in dumps that assays 14 oz. silver and 80c. in gold is to be treated.

SPRING VALLEY.—Two trucks are hauling 150 to 200-oz. silver ore from the Siegel mine to the railroad at Ray, a distance of 20 miles. The Siegel is worked through a 6000-ft. tunnel and there is estimated to be exposed 125,000 tons of ore that assays 20 oz. silver and 20 to 30% manganese. In the American Standard, adjoining the Siegel, a tunnel, now 175 ft. long, is being driven to cut the vein at a depth of 300 ft. The objective should be reached within 100 ft. More than a carload of rich ore is ready for shipment. The El Capitan, a noted silver producer of the early days, also adjoins the Siegel.

IMLAY.—The Majuba Silver, Tin, and Copper Mines Co., organized last fall for further development of the

Majuba Hill mine, is opening, by four tunnels, low-grade copper, silver, tin, and zinc ore. The mine was first worked by the Mason Valley company, owner of the Thompson smelter, and this company shipped to the smelter 2000 tons of 12% copper ore containing $1\frac{1}{2}$ oz. silver. All work in the veins has been done in the upper leached zone and the present work is being done to reach greater depth, with the object of finding persistent shoots of copper ore. There is blocked out 50,000 tons of ore containing 3% copper and 2 oz. silver.

RAILROAD SPRINGS.—The Silver Coin Mining Co. has been organized to develop nine claims on which a favorable report has been made by J. K. Turner, a Goldfield engineer. There are three quartz veins in limestone and shale. The fissures are filled with sulphide of iron and crushed quartz and a distinct clay gouge separates the veins from their walls. The best showing of ore is in a 70-ft. shaft, with 25-ft. drifts on the 50-ft. level, and assays secured by Mr. Turner from these workings indicate that the Silver Coin is an exceptionally good prospect. Ore is exposed continuously from the surface to the bottom of the shaft and in both drifts. The shaft samples gave returns as follows: 2-ft. width, 37 oz. silver, 0.04 oz. gold; 6-in., 37.09 silver, 0.265 gold; 2-ft., 84.02 silver, 0.16 gold; $2\frac{1}{2}$ -ft., 78.2 silver, 0.06 gold; 6-in., 111.36 silver, 0.04 gold; $2\frac{1}{2}$ ft., 87.7 silver, 0.1 gold; 6-in., 147.2 silver, no gold, lead 4%. Similar assays were secured in the drifts. The vein averages three feet wide and the best ore is found on the hanging-wall.

STONEWALL.—The Yellow Tiger tunnel at 220 ft. still is in wash from the erosion of a fault scarp, but it is estimated that the solid formation will be entered within 50 ft. Two shifts of miners are employed and two drills are used in the tunnel on each shift. The size of the tunnel is 5 by 7 ft. and in the solid formation this will be increased to 5 by 8 ft. The objective is the Stonewall vein, which should be cut at 1000 ft. from the entrance. Before the Yellow Tiger took over the claims they were developed by a shaft, which showed the vein to be greatly leached but containing good ore. The tunnel is being driven to open the vein well below the water-level.

UTAH

UTAH COPPER REPORT.

SALT LAKE CITY.—The Utah Copper Co. has issued its forty-eighth quarterly report, covering operations for the first quarter of 1920. The total quantity of ore milled was 1,283,300 tons, averaging 1.23% copper, as compared with 1,372,300 tons and 1.25% copper for the fourth quarter of 1919. The average extraction was 86.14%, as compared with 81.56% for the preceding quarter. The total quantity of copper produced was 27,257,546 lb., as compared with 27,965,470 lb. for the previous quarter. The average cost per pound of net copper produced, excluding credits for gold, silver, and miscellaneous income, was 13.20¢, as compared with 16.47¢. The net profit for the quarter was \$2,870,590, and after payment of a dividend of \$1.50 per share the net surplus for the quarter was \$433,855, as compared with \$262,721 for the last

quarter of 1919. The earnings for the quarter were computed on the basis of 21.99¢. per pound of copper; this being due to the sales of copper metal being in excess of production during the period.

PARK CITY.—The mines in this district shipped 2397 tons of ore during the week ended May 15, as against 2227 for the previous week. The Judge M. & S. shipped 718 tons; Silver King Coalition, 553 tons; Ontario, 487 tons; Daly-West, 339 tons; Daly, 108 tons. The Judge smelter shipped 192 tons of premium spelter during the past week. The annual meeting of the stockholders of the Daly-West Mining Co. was held recently at Denver, and the following directors were elected for the ensuing year: Geo. W. Lambourne, Moylan C. Fox, of Salt Lake; O. N. Friendly, of Park City; George G. Brooks, of Scranton; and Harry M. Stonemetz, of Boston. For a supposedly 'worked-out' property, the Daly-West is one of the most active mines in camp, more than 125 men being on the payroll, and this number would be increased if men were obtainable. Recent development work has been satisfactory, as high-grade ore has been opened up. During the first four months of this year the Daly-West earned enough for its full dividend requirements for 1920, after deducting all expenses and taxes.

EUREKA.—H. G. Snyder, manager of the Tintic Paymaster Mines Co., reports conditions encouraging in both the east and north drifts. In the north drift, which is tapping the vein at a depth of approximately 500 ft., he reports the ore to be improving steadily. The cross-cut to the east to cut the main fissure, which shows a width of about 200 ft. on the surface, is now in a little more than 1200 ft., and is in the hanging wall. This is being driven directly into the side of the steep-pitched mountain, and gives a vertical depth of more than 800 ft. Two shifts are employed in both parts of the property and the company is pushing the development with all reasonable speed.

Conditions in the Eureka Lily Co.'s winze on the 1640-ft. level continue to improve with depth, according to Grant H. Snyder, the manager. Some recent assays show an average of 46 oz. silver, \$4.60 in gold, and 28% copper. In the drift on the 1840-ft. level, which has as its objective the low-grade orebody encountered near the shaft on the 1640-ft. level, conditions are most promising. Although the drift is at least 50 ft. from the objective, several good stringers of copper ore have appeared in the face, which the management believes are feeders from a mineralized area directly ahead.

WASHINGTON COUNTY.—One of the largest mining transactions in Utah in recent years was made on May 18, when a syndicate represented by F. C. Moorehouse agreed to take over the development of the Silver Reef Consolidated mine at Silver Reef, under an option agreement which permits the syndicate to acquire a controlling interest in the company. The Silver Reef Consolidated comprises the Stormont, Barbee, Walker, and Christie properties, in which it is stated several hundred thousand tons of ore averaging about \$10 per ton in silver is exposed. In addition to this, there is a tailing dump

which can be treated at a profit. The syndicate will start development in June, and will expend a stipulated sum before it can exercise its right to purchase control. A pilot-mill will be constructed and operated to determine the metallurgical process to be used. The ore occurs in sandstone. In the early days, it is stated that the silver output of these properties totalled between \$10,000,000 and \$15,000,000. As depth was gained in the various workings, copper came into the ore, which introduced metallurgical difficulties that resulted in shutting down.

WISCONSIN

REVIEW OF APRIL.

Operators of zinc mines in the Wisconsin field were disappointed with results during April, because of the industrial conditions obtaining throughout the country. Just as prices for ore of good grade had reached a satisfactory level, railroads laid embargoes that practically prevented some producers from marketing, since most of the ore leaving the field must be handled by connecting lines. Coal became scarce about the middle of the month and the situation was further complicated. The price of high-grade blende opened the first week of the month on a base of \$52 per ton for 60% ore. The second week found large sellers under contract arrangements. During the third week the base advanced to \$57 per ton, on standard commercial ore. On the premium grades, ores assaying above 60% zinc, better prices obtained, some bringing as high as \$60 per ton. This figure declined as soon as the strike began to affect other lines of industry and the base price receded to \$52.50, at which figure it closed the month.

The lead-ore market was well maintained all month, the base for 80% concentrate, at mills, holding steadily at \$110 per ton. Shippers, however, seemed to nurse the idea that the price would go higher and for this reason ore ready for relivity was carried in bins. The strike conditions and the softening of the pig-lead market determined some, at the close of the month, to convert their holdings into cash. Sub-leasing of mineral tracts found favor during the month at several mines operated by the larger concerns, and many small co-partnerships were formed to mine for lead in shallow surface diggings. Unlike the buying in the zinc market, where new interests came to the rescue, lead ore practically remained in the hands of the Federal Lead Co. The reserve in the field is conservatively estimated at 1500 tons, but the ore is hard to find. Carbonate-zinc ore was in good demand all month, but shipments were light. In the northern districts it is said deposits are becoming exhausted and that it is only a matter of a short time before mining will be abandoned. There are a half dozen fine mills in the district now standing idle. Small lots of iron pyrite were sold from one of the separating plants, but the bulk of this ore recovered at the refining plants was carried along and the reserve runs up into the thousands of tons. The amalgamation of certain steel and black-pipe manufacturers in the

East into a corporation known as the United States Steel & Pipe Co. involves certain corporations in the Wisconsin field. The Vinegar Hill Zinc Co., operators of zinc mines, and the National Zinc Ore Separators Co. have become subsidiary organizations. An acid-plant, built by the Government at New Diggings, has been disposed of by sale of machinery to Chicago junk dealers



MAP SHOWING THE PLATTEVILLE DISTRICT, WISCONSIN

for \$46,000; the buildings were sold to the Wisconsin Zinc Co. and will be used for the storage of zinc ores.

Deliveries of zinc ore and lead ore, for April, were made from mines to refineries in the field as follows:

District	Zinc, lb.	Lead, lb.
Benton	10,246,000	244,000
Livingston	5,825,000	60,000
Galena	2,300,000	64,000
Hazel Green	1,300,000	.....
Cuba City	1,138,000	80,000
Millbrig	932,000	60,000
Highland	780,000	.....
Platteville	750,000	.....
Linden	492,000	62,000
Day Siding	248,000	260,000
Shullsburg	116,000	.....
Totals	24,154,000	832,000

Shipments of the high-grade blende to smelters were made by the following refineries:

Company	Lb.
Mineral Point Zinc Co.	6,100,000
Wisconsin Zinc Roasters	3,554,000
National Zinc Ore Separators	3,398,000
Linden Concentrating Co.	612,000
Block-House Mining Co.	528,000

Total 14,192,000

The recovery of ore at wet mills in the field for the month amounted to 11,887 tons; net deliveries to smelters, 7256 tons of blende and 390 tons of carbonate-zinc ore. The high-grade was distributed among the following buying concerns: Illinois Zinc Co., 772 tons; M. & H. Zinc Co., 205 tons; Grasselli Chemical Co., 998 tons; American Zinc Co., 725 tons; United Zinc Corporation,

99 tons; Prime Western Smelters, 984 tons; Mineral Point Zinc Co., 3050 tons.

BRITISH COLUMBIA

GOVERNMENT ASSISTS DEVELOPMENT OF SALMON RIVER DISTRICT.

STEWART.—The Provincial government, as a result of recommendations made by George Clothier, resident engineer, proposes the expenditure of a considerable sum this year in further opening up the Salmon River mineral area, as well as the zone north of the Portland Canal division. The wagon-road, built last year to the Premier mine, will be continued and trails will be constructed to assist operators and prospectors. In order to make the recording of minerals claims staked in this country easier the whole of the region around the headwaters of the Naas, Unuk, and Iskut rivers has been included in the Portland Canal mining division, so that hereafter prospectors will travel along the line of the Salmon river, making use of the trails referred to, to Stewart to make official record of their claims and assessment work. The section to the south will be administered as before from Anyox, where there is a mining recorder. Previously it was thought to be easier to reach Anyox from the headwaters of the Unuk, Naas, and Iskut than to get to Stewart, owing to the intervening coast mountains.

BARKERVILLE.—L. A. Bonner, manager of the Lighting Creek Hydraulic Co., Cariboo, who returned recently from a business trip to England, states that the season in northern British Columbia in respect of placer mining is extraordinarily backward. A few weeks ago he snow-shoed into his property over four feet of snow and expects that later on trouble will be experienced through freshets. Mr. Bonner looks for an increased output of placer gold from the Cariboo this season, notwithstanding the handicap which the operating companies face owing to the scarcity of labor.

TRAIL.—The development work that has been carried on steadily for some time at the Consolidated M. & S. Co.'s Sullivan mine, at Kimberley, is beginning to show in the weekly ore-shipments that are received at Trail. During the week ended May 7, the Sullivan contributed 10,266 tons of zinc and 489 tons of lead ore toward the total ore-receipts for the week, which were 12,103 tons. The other principal producers were the Josie, Rossland, with 499 tons; Blue Bell, Riondel, 153 tons; North Star, Kimberley, 255 tons; and No. 1, Ainsworth, 114 tons. Peter Dunkerley, who has been in the employ of the Consolidated company for more than 20 years and who for the past 12 years has been purchasing agent, was presented with a gold watch by the office staff of the company on the occasion of his recent retirement.

PRINCE RUPERT.—The Algonican Syndicate has made arrangements with the Canadian Northwestern Railway Co., owners of the Portland Canal short line, to repair the line and utilize it for shipping equipment and supplies to the Fitzgerald group, on Goose creek, which the syndicate has under option. The syndicate has called

for tenders for the repair of the bridges over Bitter creek and Bear river and for several lengths of trestle-work. The Taylor Mining Co. has sent a crew of some 100 men from Vancouver to Alice Arm to replace the men on strike at the Dolly Varden mine and at the railway.

ONTARIO

NEW TRIBUNAL TO SETTLE DISPUTES INVOLVING PATENTED CLAIMS.

A bill is now before the Ontario Legislature for establishing a tribunal to be known as the Mining Court of Ontario, which will have authority to deal with all mining disputes, whether in regard to patented or unpatented mining claims. At present the Mining Commissioner has the power to decide disputes involving unpatented mining claims only. The measure under consideration invests him with the full power of a judge of the County court, and has the cordial approval of mining men and the legal profession of Northern Ontario, on the ground that cases will be determined with less delay and expense than under the existing system.

KIRKLAND LAKE.—The shaft at the Bidgood is now down about 50 ft. on a vein eight feet wide with results stated to be satisfactory. The contract provides for sinking to the 200-ft. level and 2000 ft. of lateral work. The Hunton-Kirkland has purchased mining machinery which will be placed as soon as possible. A right-of-way for power-transmission has been cleared and contracts for supplies are being negotiated. The Jerred group of claims, five in number, with an approximate area of 200 acres, situated south-west of Mud Lake, has been bought outright by the Boston-McCrea interests and work is to be begun immediately. A highly mineralized vein, carrying gold tellurides, has been traced for 200 ft. on the surface and a shaft is down 15 ft. At the Wood-Kirkland a vein upward of 20 ft. in width has been opened in the contact between the quartz-porphyry and feldspar-porphyry formations. The Harvey-Kirkland, a new company, is operating two claims south-east of the Tough-Oakes and has uncovered several good veins on the surface.

COBALT.—At the middle of May, with quotations for silver having declined a fraction below \$1 per ounce, the question of the possible future trend is the leading topic of discussion in the Cobalt district, where not only the entire community owes its means of livelihood to the silver-mining industry, but where the wage-scale of the mine is based upon the quotations for silver. A point being emphasized, however, is that in the aggregate, the mines of Cobalt produce their silver at a cost of not far in excess of 60c. per ounce. Production from the Kerr Lake mine for April amounted to 61,000 as compared with 99,400 oz. in March. The decline is believed to be permanent, owing to the high-grade ore-shoots becoming partly exhausted, thus making it necessary to treat more medium-grade ore. The plant to treat about 75,000 tons of low-grade ore in the dumps is still under contemplation and a definite announcement may be made within the week.



THE MINING SUMMARY

COLORADO

Breckenridge.—Silver-lead ore assaying 70 oz. silver, in a four-foot vein, has been opened up by Germania lessees. Two carloads of sorted ore were shipped to the Arkansas Valley smelter at Leadville last week. Local operators have formed a leasing company to operate the Missouri property on Shock hill. The shaft, 50 ft. deep, is to be sunk to 125 ft. to cut the blanket vein dipping into the Missouri from the Iron Mask adjoining.

Clear Creek County.—Operations have been resumed on the Two Brothers mine at the top of Virginia canyon, Idaho Springs. The property was active last summer but suspended operations during the winter months. In the Georgetown district the compressor-plant at the Sunburst is again in operation and contractors are driving the Astor-Stewart cross-cut to the junction of the Astor-Stewart veins that produced rich ore in the early days of the district. Erickson & Co., leasing above the Grant level of the Sunshine, has a 25-ton shipment ready to be hauled that is estimated to assay 150 oz. silver and 18% lead.

IDAHO

Coeur d'Alene.—According to reports just received, the Cedar Creek Mining & Development Co. has resumed operations on its property near Murray. A large body of low-grade lead ore was disclosed several months ago. Development is proceeding on the 200-ft. level of the Chicago-Boston mine, on Lake creek, two miles south-west of Wallace. Samples of the ore opened in the drift are rich in lead and silver. The Hypotheek Mining & Milling Co., in the Couer d'Alene, has driven its cross-cut 160 ft. Arrival at a vein is expected at a point 140 ft. ahead where a depth of several hundred feet will be attained.

Moscow.—In co-operation with the U. S. Bureau of Mines and the Idaho Bureau of Mines and Geology, the University of Idaho offers in the School of Mines a number of fellowships, open to college graduates who have had training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is \$900 per year for the twelve months beginning July 1, 1920. Fellows will register as students in the University of Idaho and become candidates for the degree of Master of Science in Mining and Metallurgy, unless this or an equivalent degree has been earned. Their class work will be directed by the heads of the department of instruction, but the greater portion of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the University. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Idaho. For 1920-'21 the following subjects are being considered:

- (1) Flotation—with especial reference to differential separation of various minerals.
- (2) Treatment of the complex gold-silver ores of the State.
- (3) Ore-dressing problems.
- (4) Mining problems.

Applications, with certified copy of collegiate record, statement of professional experience, and names and ad-

dress of three references will be received up to June 15, 1920. The applications should be addressed to Francis A. Thomson, Dean, School of Mines, Moscow, Idaho.

MINNESOTA

Duluth.—Mining operations on Minnesota iron-ranges are being curtailed owing to coal shortage, and unless immediate relief comes, mines will be forced to operate with reduced forces and ultimately shut-down to conserve coal for



MAP OF NEVADA

the operation of pumps. Ore shipments from the Hibbing district recently have been less than half of normal. The Oliver Mining Co. has stopped stripping work, and the Shenango Furnace Co. has closed down. Underground work and shovel-operations in the Virginia district have been cut to a minimum. Meanwhile the companies are making every effort to keep men employed and organizations intact. Large numbers of men are working only half time, however.

MISSOURI

Joplin.—A loss estimated at more than \$100,000 was caused by fire of unknown origin that destroyed all of the

principal buildings at the Freehold Oil & Gas Co.'s zinc and lead mine, No. 2, two miles south-west of Waco. The loss was partly covered by insurance. It has not been decided whether or not the mill will be re-built. It was constructed about a year ago and is one of the heaviest producers in the Waco field. The mill had a capacity of 200 tons per day.

NEVADA

Mina.—Silver-lead-zinc ore of good grade, containing \$3.20 in gold per ton, has been found in drift No. 615, on the sixth level of the Simon Silver-Lead mine. This is a continuation of cross-cut 603, driven 580 ft. south-westerly from the main shaft to pick up the faulted segment of the principal orebody, which has been thrown by the west fault.

Pioche.—At the Prince Consolidated from 2½ to 3 ft. per day is being made in the three-compartment shaft now being sunk to open up silver-gold ore which was found by diamond-drill prospecting. No trouble is being had with water, in fact the work is not developing nearly the flow of water expected so that the pumping equipment in use when shaft operations started has been found to be ample to keep the shaft dry.—It is reported that G. E. Bateman after demonstrating in a pilot-mill that he can recover the metal in the Bullionville and Dry Valley tailing, has gone to California to order immediate shipment of machinery and equipment for a 100-ton mill.

The Alps Mining Co. has acquired the Alps mine, one mile east of Pioche, and secured Dan Lloyd as superintendent. The 300-ft. shaft will be repaired and development pushed. The property has produced much good ore and is said to be far from worked out.

Virginia City.—The United Comstock Mines Co. has been incorporated, with a capitalization of \$5,000,000, by Arthur I. Erb, Roy H. Elliott, and Rufus Thayer to operate a combination of properties on the Gold Hill section of the Comstock lode. Stock is divided into 5,000,000 shares, par value \$1. It is understood the Humpries, Jackling, and Bulkeley Wells interests are chiefly concerned in the corporation.

NEW MEXICO

Socorro County.—The work of re-opening the old Colossal Silver mines in the Black range is progressing. The mines have been idle during the past ten years, and the development work is being done by an Albuquerque corporation, which expects to be producing high-grade ore by the first of June. An entire new outfit of machinery has already been placed, and a concentrator will be put in soon.

UTAH

Milford.—Steps are being taken to open up the Sheep Rock Mining & Milling Co.'s property, situated in the Newton district, in Beaver county, about 40 miles from here. The property, which consists of ten patented mining claims, embracing 177 acres, is equipped with a 25-hp. electric hoist, air-compressor, and other machinery. The mine in by-gone days shipped ore direct to the smelter, but engineers who have examined it are of the opinion that the ore can be handled to best advantage by the cyanide process.

Alta.—Development work has been resumed at the Louise mine, with good results, according to R. O. Dobbs, general manager. A raise from the Maggie tunnel struck a bed of galena, samples from which average from 45 to 61% lead and from 19 to 36 oz. of silver per ton. Another condition which makes officials confident that an orebody will be opened up along the Cardiff contact in the Louise property is that recently in the contact tunnel at a point 600 ft. on the dip of the contact below the ore in the Maggie workings, 20 ft. of vein matter, consisting of lime and manganese-stained lime and clay gouge has been opened up. Since beginning work on the contact vein in the spring of 1918, over 3000 ft. of development work has been done.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

H. Brings, of New York, has gone to France.

Gerald H. Hutton is here from Dayton, Nevada.

L. S. Cates is at the Ray copper mine, in Arizona.

Fred J. Siebert has returned from Arizona to Reno.

Owen F. Brinton, of Salt Lake City, is at Basin, Montana.

Joseph T. Ruth is returning to Denver from Nacoziari, Mexico.

Alma Ek, mechanical engineer for the Braden Copper Co., is in Utah.

H. Kenyon Burch has returned to Los Angeles from Warren, Arizona.

Marshall Bond called here on his way from Santa Barbara to Vancouver.

W. W. Mein, of New York, will spend four months at Lake Tahoe, California.

Edwin Higgins has returned from a visit to the Fremont mine in Amador county.

John L. Dynan, of the Tonopah Extension Mining Co., was in San Francisco this week.

F. M. Jardine has been appointed mill-superintendent for the Butte & Superior Mining Co.

Charles Bocking, manager for the Butte & Superior Mining Co. at Butte, is in New York.

J. C. Emison, treasurer of the A. S. & R. Co., was in Utah recently, visiting the company's smelters.

Harry J. Wolf, of New York, was in San Francisco this week on his way from Arizona to Nampa, Idaho.

Raymond Brooks, formerly of New York, is now with the Union Minière du Haute Katanga, in the Belgian Congo.

F. O. Jasmer has resigned his position with the Cias. del Agwi, S. A., and has opened an office at Tampico, Mexico.

Fred. G. Farish, general manager for the Metals Exploration Co., is in San Francisco. He will spend several weeks in California.

E. DeWitt Burlingame, in charge of the welfare department of the Braden Copper Co. at Rancagua, Chile, is at Salt Lake City.

D. D. Moffat, consulting engineer of mills for the Jackling companies, is visiting the Ray and Chino mills in Arizona and New Mexico.

Byron O. Pickard, recently appointed district engineer of the U. S. Bureau of Mines, with headquarters in San Francisco, has been spending a week in Utah.

H. K. Armstrong has resigned from the Liberty Bell Gold Mining Co., Telluride, Colorado, to go to the American Silver Corporation, at Mogollon, New Mexico.

George H. Garrey will become consulting engineer to the Tonopah Divide company on June 1. At the same time **William Waters** will resume his position as superintendent of the mine.

E. P. Mathewson spent several days in Salt Lake City recently on his way to Anyox, British Columbia, where he expects to remain several months. On May 10 the Colorado School of Mines conferred upon him the degree of Doctor of Science.

At its annual meeting on May 19, the Utah Society of Engineers elected the following officers: **H. T. Plumb**, president; **LeRoy Pharis**, first vice-president; **E. H. Beckstrand**, second vice-president; **W. E. Turner**, secretary; **R. K. Brown**, treasurer; and **L. J. Seckles**, member of the executive committee.

F. E. McDonald, millman for the North Idaho Metals Co., at Kellogg, Idaho, was instantly killed on May 11.

THE METAL MARKET



METAL PRICES

San Francisco, May 25

Aluminum dust, cents per pound	65
Antimony, cents per pound	10
Copper, electrolytic, cents per pound	19
Lead, pig, cents per pound	8 75-9 75
Platinum, pure, per ounce	\$95
Platinum, 100, iridium, per ounce	\$130
Quicksilver, per flask of 75 lb.	\$80
Spelter, cents per pound	9 75
Zinc dust, cents per pound	12 50-13 00

EASTERN METAL MARKET

(By wire from New York)

May 24—Copper is inactive but steady. Lead is quiet and firm. Zinc is lifeless and lower.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01 1/2 on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York	London	Average week ending
May 18	90.75	58.37	123.75
" 19	90.75	58.25	70.75
" 20	90.75	58.25	118.12
" 21	90.75	58.50	68.41
" 22	100.75	59.25	117.07
" 23 Sunday			69.08
" 24	101.00		65.14
			105.50
			101.21
			58.50
			100.12
			58.52

Monthly averages

Date	1918	1919	1920
Jan.	88.72	101.12	132.77
Feb.	86.79	101.12	131.27
Mch.	88.11	101.12	125.70
Apr.	95.35	101.12	119.56
May	99.50	107.23	
June	99.50	110.50	

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
May 18	19.00
" 19	19.00
" 20	19.00
" 21	19.00
" 22	19.00
" 23 Sunday	19.00
" 24	19.00

Monthly averages

Date	1918	1919	1920
Jan.	23.50	20.43	19.25
Feb.	23.50	17.34	19.05
Mch.	23.50	15.05	18.49
Apr.	23.50	15.23	19.23
May	23.50	15.91	
June	23.50	17.63	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
May 18	8.50
" 19	8.50
" 20	8.50
" 21	8.50
" 22	8.50
" 23 Sunday	8.50
" 24	8.50

Monthly averages

Date	1918	1919	1920
Jan.	6.85	5.60	6.65
Feb.	7.07	5.13	8.88
Mch.	7.26	5.24	9.22
Apr.	6.99	5.05	8.78
May	6.88	5.04	
June	7.59	5.32	

TIN

Prices in New York, in cents per pound:

Date	1918	1919	1920
Jan.	85.13	71.50	62.74
Feb.	85.00	72.44	59.87
Mch.	85.00	72.60	61.92
Apr.	85.53	72.50	62.12
May	100.01	72.50	
June	91.00	71.83	

Monthly averages

Date	1918	1919	1920
Jan.	93.00	70.11	
Feb.	91.33	62.20	
Mch.	80.40	55.79	
Apr.	78.82	54.82	
May	73.87	54.17	
June	71.52	54.94	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound:

Date	Average week ending
May 18	8.05
" 19	8.00
" 20	7.95
" 21	7.90
" 22	7.90
" 23 Sunday	
" 24	7.95

Monthly averages

Date	1918	1919	1920
Jan.	7.78	7.44	9.56
Feb.	7.97	6.71	9.15
Mch.	7.87	6.53	8.93
Apr.	7.04	6.49	8.78
May	7.92	8.43	
June	7.92	6.91	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			May	11	85.00
Apr.	27	97.00	"	18	85.00
May	4	97.00	"	25	80.00

Monthly averages

Date	1918	1919	1920
Jan.	128.06	103.75	89.00
Feb.	118.00	90.00	81.00
Mch.	112.00	72.80	87.00
Apr.	115.00	73.12	100.00
May	110.00	84.80	
June	112.00	94.40	

MONEY AND EXCHANGE

Francis H. Sisson, vice-president of the Guaranty Trust Co., sees danger in forcing too rapid deflation. He is quoted as saying:

"The chief danger in the present situation is that the desirability for low prices as an end in itself may be so exaggerated as to lead to the attempt to force prices down through harmful measures for the control of credit. The notion seems to prevail that the war-time and post-war rise in prices was on the whole disadvantageous to the country. Prices moved up irregularly with consequent maladjustment, some individuals gaining while others were injured by the changes. Even when it is granted that resort in some degree to measures tending to raise prices was necessary during the War, it is thought by some that the evils incurred by the rising prices may and should now be matched by the supposed benefits of falling prices. Those who look merely at the mechanical aspects of the exchange of goods find so much money and credit on the one hand measured against so much of goods on the other—with prices expressing the ratio between the two. Accordingly, the desired lower prices may readily be obtained, it is thought, by arbitrarily reducing the volume of money or credit, especially the latter. Such action has been repeatedly advocated.

"There seems to be no question that undue speculation should be curbed by restricting further the credit employed in such undertakings. Beyond this, however, there is a distinct danger in attempting arbitrarily to reduce general prices by curtailing credit to business undertakings. It is to be remembered that such credit is the outgrowth of business demands. It is not as if a given volume of credit should exist independently of business needs, forcing itself upon an unresisting business public. The proper function of the credit machinery is to adjust the volume of credit to the actual needs of legitimate business. Accordingly, the influences determining the credit sought and granted should have their initiative in the field of industry and trade. If the control of credit is such as arbitrarily to fix the volume of credit extended to business undertakings, it may, indeed, succeed in lowering prices of goods already produced and awaiting consumption—namely, as one line of production largely absorbs and utilizes the products of another, and since the curtailment of credit tends to a slackening of business activity, but there is no assurance that the lessening of industrial output occasioned thereby will correspond to the actual state of demand and the needs of the business community.

"The urgent need for wise leadership in the handling of our industrial and financial problems is not a matter concerning only our domestic affairs. We are confronted now with the unique opportunities for the development and strengthening of our position in world enterprise. There is promise of a coming period of rapid development of the newer regions of the world, the storehouses of the principal natural resources upon which the industry and trade of the future will largely be based. The more easy and natural we can make the necessary readjustments in our industry and finance the better able we shall be to share in the benefits of the prospective period of expansion. Elsewhere such opportunities are being recognized and utilized.

"It is significant to note that, despite the present handicap of adverse exchange, the volume of British foreign trade is rapidly approaching our own, and Great Britain still has the largest merchant marine, and London is still the financial centre of the world."

Foreign quotations on May 25 are as follows:

Sterling, dollars; Cable	3.84 1/2
Demand	3.85 1/2
Francs, cents; Cable	7.94
Demand	7.98 1/2
Lire, cents; Demand	5.35 1/2
Marks, cents	2.71

Eastern Metal Market

New York, May 19.

All the markets are still under the blight of the transportation muddle but prices in most cases are steady.

Demand for copper is still light but quotations are firm.

Heavy buying of future-shipment Straits tin has continued but spot Straits is scarce.

The lead market is dull with the price-range indefinite.

There is still no life to the zinc-market and prices are easier.

Antimony is a little lower.

IRON AND STEEL

Reports indicate little improvement in the shipping situation, but hopeful signs, wanting a week ago, point to an early resumption of railroad traffic, says 'The Iron Age'. With the immediate cessation of the strike it would take six to eight weeks to recover the operating pace of March. The present natural stagnation in business is not accompanied by any softening of prices as would normally occur under such a condition for, besides full order-books, a slump in buying will be offset by the necessarily gradual resumption of the mills. There are 1,300,000 tons of finished products in yards and warehouses in the Pittsburgh district alone and the leading interest has probably 600,000 tons of unshipped material, and in the whole country the undelivered manufactured steel is not far short of 2,000,000 tons.

Premiums are disappearing, partly because inability to make prompt shipments removes the chief reason for their being. Pittsburgh is operating at about 75 % of ingot capacity, while Youngstown is at less than 50 %. Shipments of semi-finished steel have been rather heavier, in proportion to other forms, than usual.

COPPER

The transportation situation is probably the most important factor in this market and its evil effects are apparent. It develops that some of the large refiners are facing a depletion in their supply of crude copper from smelters, many tons of this being held in transit at the railroads. Some drastic means have been necessary to obtain needed supplies in some cases. The same is true of shipments of refined metal on contract. Raw material and finished copper are not moving freely and unless an improvement develops speedily it may be necessary for some refiners to shut-down. This matter is also serious from a credit or financial point of view and is causing concern. The net result is that consumers are not free buyers and only small amounts of Lake or electrolytic copper are being sold. Quotations of leading producers are firm at 19c., New York, for both electrolytic and Lake copper for May-June delivery, with 19.25c. asked for delivery in the third quarter. In the outside market quotations range from 18.50 to 18.75c., New York, for both grades of copper with but little available.

TIN

Sales of future-shipment Straits tin have continued on a large scale, the total since May 10 having been over 700 tons. This with the 1100 tons sold the previous week, brings the total recent sales to at least 1800 tons. On May 11, sales were light at 75 tons; on May 12 the total was 125 at prices ranging from 55.50 to 56.25c.; on May 13, they were 425 tons at 53.87½c. for July-August shipment, to 54.75c. for April-May shipment; and on May 14 they were 100 tons at 54.75c. for May-June shipment, to 55.25c. for June shipment. These transactions were mostly among dealers although consumers participated to some extent; they were also made on the New York Metal Exchange. There appears to be a shortage of spot-Straits tin which today is quoted at 54.75c., though it has hung around 56c.

most of the week, where it has appeared to be pegged. An evidence of the shortage of Straits tin is the fact that on an inquiry sent to London for June arrival here, this grade of tin was reported unobtainable. This shortage will result in a demand for other grades. There has been a good business in Banca tin which has sold at 2 to 3c. under the price for Straits. On Monday, this week, inquiry has been fair with the market quiet. The London market yesterday was £302 per ton for spot Straits and £287 for spot standard tin, an unusually wide spread, and a further illustration of the scarcity of the former grade. Arrivals thus far this month have been 2745 tons with 4670 tons reported afloat. Tin ore arrivals thus far this month have been 3675 tons.

LEAD

The market has again taken on a mixed character. Buyers seem to have lost courage and are inclined to let the market alone. Some sellers are 'whistling to keep up their courage'. The price-range appears to be a wide one with some interests talking 9.25c., New York, for lead in the first half of June, while others have offered the metal down to 8.50c., New York, in some instances. We quote the market at 8.15c., St. Louis, or 8.50c., New York. The leading interest maintains its quotation at 8.25c., St. Louis, or 8.50c., New York.

ZINC

This market continues lifeless and uninteresting. There are no developments except a slight easing in values. Prime Western for delivery into July is quoted at 7.70c., St. Louis, or 8.05c., New York. Sellers are not interested at these levels and demand from consumers continues light.

ANTIMONY

The market is quiet with the better grades quoted at 9.75 to 10c., New York, duty paid, with lower-grade material obtainable at 9.50c., New York, both in wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99 % pure, for early delivery in wholesale lots, is quoted at 33c., New York, from the leading producers, with 31.50c. asked by other sellers.

ORES

Tungsten: Freight congestion in New York has adversely affected a market already 'in the dumps'. As a result almost no business has been done. Prices are nominally unchanged at \$7 to \$15 per unit in regular concentrates, depending on the grade. Imports of tungsten-bearing ores in March were 217 tons of which 100 tons came from China and 44 from Chile. Total imports for the nine months ended with March 31, 1920, have been 4961 tons against 9961 tons for the same nine months a year ago.

Ferro-tungsten quotations are unchanged at 85c. to \$1.15 per lb. of metal in the alloy or the powdered metal.

Molybdenum: This market is also dead with quotations nominal at 75c. per lb. of MoS₃ in regular concentrates.

Manganese-Iron Alloys: Except for active requests from consumers for shipment of ferro-manganese on contract there is very little change in this market. Prices are the same as a week ago. A large Philadelphia producer will soon start a furnace which is expected to produce 2500 tons per month and another in June which will make 2000 tons per month. It is rumored that two large steel companies plan to produce the alloy in the near future. A producer of ferro-alloys by means of electric furnaces in Alabama will soon produce ferro-manganese, it is understood. Spiegel-eisen is strong but only moderately active at \$75, furnace, at which some sales have been reported.

Company Reports

NIPISSING MINES COMPANY, LTD.

Report for the year ended December 31, 1919.

Property: mine and mills in the Cobalt district, Ontario.

Operating Officials: R. B. Watson, general manager; Hugh Park, manager; James J. Denny, manager of the research department.

Financial Statement: gross settlements for the year, \$4,941,791; value of custom ore purchased and inventory of December 31, 1918, \$2,282,818; gross value of 1919, Nipissing production, \$3,752,083. Cost of mining and treatment, \$1,083,251. Net income from 1919 production, \$2,717,312. Net profit, \$2,776,250. Net surplus December 31, 1919, \$4,372,952.

Dividends: during 1919, \$1,800,000, making total to date \$20,940,000.

Development: The amount of underground work done during the year was about the same as in the previous year, notwithstanding two months shut-down during the strike. Development work was more satisfactory than in 1918, because of the good results obtained on veins 99 and 109, and on the extension of 73 vein at the third level. Exploration, that is, the search for ore in new territory, made up 70% of the total advance. The older veins, after sending 48,361 tons to the mill, show a decrease of only 12,802 tons.

A summary of the remaining ore-reserves follows:

	Tons	Assay, oz.	Content, oz.
High-grade ore	2,896	1373.0	3,976,774
Mill ore	113,165	20.9	2,377,882
Total	116,061	54.8	6,354,656

Production: shipments of silver amounted to 3,080,069 oz. The costs are computed on a basis of 66,202 tons of ore produced, of which 962 tons was treated in the 'high-grade' mill.

SILVER KING CONSOLIDATED MINING CO.

Report for the year ended December 31, 1919.

Property: mine and mill at Park City, Utah.

Operating Official: Harry A. Lee, consulting engineer and assistant manager.

Financial Statement: receipts included \$62,248 from sales of ore, \$128,200 from convertible notes, and \$46,600 from sales of stock. Total, \$341,742. General expense, \$58,316; development and mining, \$58,873; tunnel account, \$103,814. Total, including miscellaneous, \$308,755.

Dividends: no dividends during 1919. Total to date, \$1,562,705.

Development: present activity is confined largely to the development of the Silver King ore-zone by means of the Spiro tunnel.

Production: 780 tons of crude ore containing 24,608 oz. of silver and 443,652 lb. of lead, and 572 tons of concentrate containing 9,412 oz. of silver and 299,292 lb. of lead was marketed.

ALASKA JUNEAU GOLD MINING CO.

Report for the year ended December 31, 1919.

Property: mines and mills at Juneau, Alaska.

Operating Official: P. R. Bradley, general superintendent.

Financial Statement: revenue from bullion, \$400,644; from concentrate sold, \$142,070; total \$542,714. Operating and development expenditures, \$702,303; construction and other expenses, \$355,776. Total expenditures, \$1,058,079. Balance sheet shows a deficit of \$563,625 on December 31, 1919.

Dividends: none to date.

Development: 10,814 ft. of advance was made during the year, the work being confined to the North orebody, chiefly in preparation of No. 410 and 420 stopes. The plan of

'waste rejection' was further developed and at the end of the year one-third of the rock delivered to the mill was being rejected. This material assayed less than the mill tailing. Reconstruction of the mill, designed to reduce costs and increase capacity, progressed to the point where 8000 tons can be handled. The final capacity will be 16,000 tons per day of rock from the mine, of which one-half will be rejected as 'coarse' tailing by sorting. Additional mine equipment will be necessary to handle this output.

Production: 673,421 tons of ore was stoped; 19,474 tons came from development work; 616,302 tons of fine ore was milled. The ore averaged \$1 in gold; 64c. per ton was recovered as free gold, and 18c. per ton was realized on galena concentrate.

MIAMI COPPER CO.

Report for the year ended December 31, 1919.

Property: mines and mills in the Miami district, Arizona.

Operating Officials: F. W. MacLennan, general manager; J. H. Hensley, Jr., mine superintendent; F. W. Solomon, mill superintendent.

Financial Statement: actual profits after taxes, but before depreciation and depletion, were \$1,582,701. The company reserved \$295,695 for depreciation and \$1,806,748 for ore-depletion; surplus of current assets over current liabilities at the close of the year amounted to \$6,939,990, as compared with \$7,146,093 at the end of 1918.

Dividends: during 1919, \$1,867,785; total to date \$21,462,829.

Development: work to the amount of 14,552 ft. was done, made up of 12,937 ft. of drifts, 1587 ft. of raises, and 28 ft. of shaft-sinking; 75% was for the purpose of preparing for, and maintaining, ore production from the main orebody by the undercut caving system of mining which was introduced in this orebody during the year. New development during the year resulted in very slight changes in the boundary of the high-grade orebody, and estimates place the tonnage of this class of ore at 11,054,349 tons of an average grade of 2.38% copper. There was very little churn-drilling done and this was confined to the low-grade area, consisting of completing hole No. 117 for a depth of 469 ft.; 36,000,000 tons of an average grade by drill sampling of 1.06% copper is reported in reserve, in addition to 6,000,000 tons of mixed ore averaging 2%.

Production: 1,698,466 tons of ore averaging 2.04% of copper produced 65,544 tons of concentrate averaging 43.54%, with a mill extraction of 82.38%. The total refined copper produced was 54,221,638 lb., amounting to an average monthly production of 4,518,470 lb.

MINING CORPORATION OF CANADA

Report for the year ended December 31, 1919.

Property: mines at Cobalt; the Cobalt Reduction Co.'s mill and the Buffalo mines.

Operating Official: M. F. Fairlie, resident manager.

Financial Statement: revenue from sale of bullion \$1,411,184, which with sundry income made a total of \$1,689,996. Total cost \$735,724; net profits \$954,272. Surplus on December 31, 1919, \$3,311,577.

Dividends: during 1919, \$622,519.

Development: the total ore-reserve is made up of 15,716 tons carrying 440,275 oz. in place, and 23,019 tons carrying 866,945 oz. of broken ore in stopes and on dumps. An increase in both tonnage and silver content over the previous year is shown in reserve, this new ore having been largely developed in stoping operations. During 1919 the corporation continued its general activities and its search for mining properties.

Production: the total tonnage was 63,904 tons, the total ounces recovered being 1,230,653, of which 72,193 oz. was from high-grade ore.

Book Reviews

Technical Writing. By T. A. Rickard. Pp. 173, index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$1.50.

It is appropriate that T. A. Rickard should have written and that the house of Wiley should have published this practical volume of hints and inspiration for those who seek to express neatly, accurately, incisively, the information they would convey to the world. Whatever is worth doing at all is worth doing well. We ordinarily send for the carpenter when we would build a book-case; some of us possess the skill to build it creditably ourselves. Everyone of us should be able to do so, because the elemental trades, in their elementary stages of development, should constitute part of the training of men who would be adequately equipped for civilized life. Expression is also a trade, common to all men, though in varying degree. Like the hammer and saw, simple primal tools of everyday life, words are the instruments for driving our ideas into the understanding of other men. Instinctively man turns away in annoyance from a botched job. That is why most of us take no chances of ill-matched boards in a book-case, but send for the carpenter. The new generations, schooled in sloyd, will be able again, as were our great-grandfathers with their wide culture in the fundamentals of life, to make the book-case themselves.

Even an old dog may be taught new tricks if his interest be sufficiently aroused, for educating dogs and men is mainly a question of inspiring the learner so that his attention is absorbingly concentrated upon the things presented by his teacher. It is in the light of this illustration that the value of Rickard's 'Technical Writing' is to be estimated. Being himself as remote as the Himalayas from the literary sin of 'fine writing', save when done with that open self-consciousness that transmutes it into humor, he sets up no standard that may weary or affright any person who would acquire a more finished technique with the simple tools of verbal expression.

The character of the book is as unpretentious as that remarkable series of Bendigo papers which first gave the mining profession warning that there had occurred a happy conjunction in Rickard of a technologist and a writer of the first order. He had a message; he knew how to deliver it. Such skill as that is not to be attained by all. It is not necessary, however, to be an art-craftsman, to be a good and capable carpenter, able to make something that is both acceptable and pleasing, even without citing the high cost of living as an excuse. The thing that any man, having a common-school acquaintance with Lindley Murray's elements, can learn to do with Rickard's 'Technical Writing' is to avoid making a botched job of his commitment to paper of the ideas he would express. The first and foremost thing, of course, is to have something to impart, and every man engaged in the practical business of mining ores and smelting metals from them has acquired some knowledge that is not common property. Each individual's experience holds something that is original, that is just as new and different as his face is different among all the millions of men on the planet. Civilization advances by recording these fresh bits of knowledge, and he who does not record his, thereby cheats the world of its due. We owe it to our fellows who have written for us, to write for them and for those who come after, so as to make easier the way to success in the solving of their daily problems.

Looked at in this practical light, the preparation of this admirable manual on the art of writing is of special personal importance to the profession, individually and collectively. One may not all at once apply every precept in the book, but its perusal will serve as an intellectual uplift, as a stimulant, as a mental clarifier. The need of such a

treatise is very great at this moment of general decadence of the English tongue. The universality of minor culture has produced so vast an audience of moderate comprehension that the newspapers and magazines vie with each other to exploit that huge body of readers, because it offers a profitable field, wherefore the most powerful periodicals of the day are allowing crass commercialism to drag them to the level of those who do not know and who care less for the correct English that has served so many distinguished generations of American and English statesmen, savants, and scientists, as a vehicle for transmitting logical thought for the progress of mankind. Confusion of speech and confusion of ideas are handmaids, and lead to slovenliness and error, not only in the teaching of science but in the promulgation of political doctrine.

Rickard quotes, as a textual justification for his book, that interesting and pungent criticism of James Barrie: "The man of science appears to be the only man who has something to say, just now—and the only man who does not know how to say it". For this alone the writing of the manual would have been warranted; but its scope is broader than the scientific field; it deals with the theory and practice of expression, which is equally vital to the economist, to the politician, to the banker, and to the man of commerce. All of these have something to say nowadays, and they are saying it in so uncertain and ambiguous a manner that the multitude knows not which way to turn for deliverance. The deluge of false social doctrine that has bewildered our world is very justly traceable to a confusion of ideas, as seen in the failure to express correctly the distinction between capital and a form of accumulated profit submerged by investment, of which the German high priest of socialism was guilty. We need clear thinking and clear writing in these days, and the fundamental condition for both is an understanding of the correct use of language.

It is this broader value of the book, gauged by the need of accurate expression by workers in every walk of life, that commends it especially at this moment. The details, as suggested by chapter headings, 'Naturalness', 'Clearness', 'Precision', 'The Relative Pronouns', 'Prepositions and Prepositional-Verbs', 'Hyphens and Compound Words', 'Style', and many more, are not those of the usual treatise on English composition. The work is as distinct in its class as the author's Bendigo papers were different and more stimulating than any other treatise on gold mines ever written. It is in the spirit of that sane French school of literature that demands straightforwardness, accuracy, and a holy abhorrence of those vagaries of style that are carelessly mistaken for genius. His basic formula, the touchstone of his every decision concerning proper usage in writing, so elementally sound as to win universal approval, is "Remember the Reader". This is the reduction of expression to its most valuable democratic function, for reaching and informing the people. One does not need to be uncultured to speak appealingly to the uncultured. The highest test of culture is the ability to employ simple terms that cannot be misunderstood by the multitude. 'Technical Writing' will prove an invaluable aid in learning how to speak directly to the point, how to recognize and weed out unsuspected errors, in diction, and the use of words that cloud the meaning.

Courtenay De Kalb.

The Book Department of 'Mining and Scientific Press' has issued a 72-page catalogue of books carried in stock in San Francisco. These publications cover a wide range of subjects in various branches of engineering and technical activity, the list being especially complete in books dealing with mining and metallurgy. A summary of the contents of each book is given, and there are indexes by authors and according to subjects. A copy of this convenient catalogue will be mailed to those interested upon request.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE BLACKSMITH AND GOOD DRILL-BITS

By D. E. Dunn

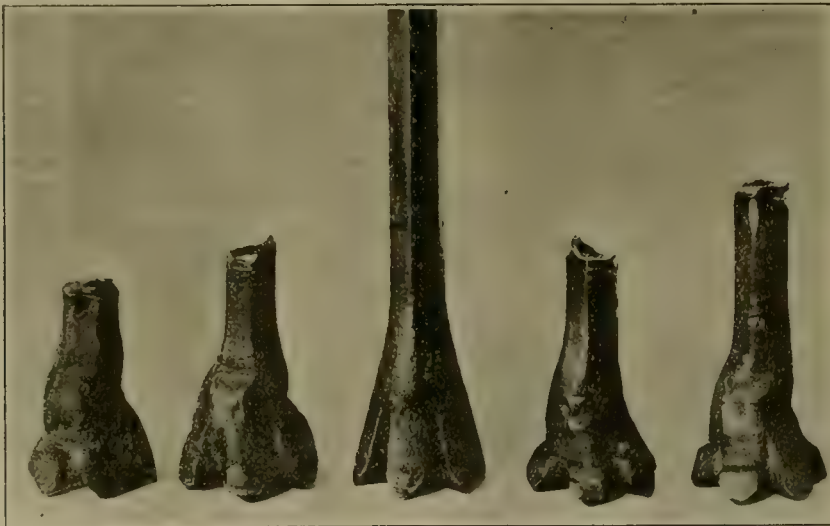
Manufacturers of rock-drilling machinery can and do make good rock-drills and drill-sharpeners. However, they can never eliminate the personal equation of the blacksmith. It would seem that the most uninformed persons would realize that the success in rock-drilling is almost entirely dependent on the blacksmith turning out good steel. While the drill-steel sharpener has gone a long way toward improving the quality of bits, even with improved machines, proper bits cannot be made without care and judgment on the part of the blacksmith.

The Ingersoll-Rand Co., manufacturers of rock-drilling

ENGINEERING FOUNDATION SEEKS ENDOWMENTS

Based on the generous gifts and high purposes of Ambrose Swasey, Engineering Foundation has since 1915 maintained a liaison between engineers, as represented by the Founder and other societies, and scientific workers, as represented in National Research Council. Practical means for co-operation in research have been set up so that engineers in the numerous branches of the profession may join with physicists, chemists, geologists, and others in the attack upon problems of common interest and in the exchange of knowledge.

Although engineers, like other professional men as a class, are not wealthy, some individual engineers have large



Some Results of Poor Blacksmithing

machinery, recently had a complaint that one of its Jackhammers was falling down on the job; in the customer's own words, "the drill didn't have any pep". One of the company's representatives investigated this case and the accompanying photograph shows the actual condition of the bits that were used in this mine. The bit shown in the centre was made by this representative with the same machine as the other four bits shown, demonstrating clearly that it was not the fault of the sharpening machine. Is it any wonder that the Jackhammer didn't have any pep?

It is found that a large number of complaints can be traced directly to bad blacksmithing, against which the manufacturers are waging a continual campaign of education. Such complaints illustrate the problems that the representatives of mining machinery companies are frequently confronted with, that is, dissatisfaction of sincere but not thoroughly informed operators.

Engineering Foundation seeks to build up its endowment to dimensions worthy of the profession. Engineers connected with industrial and financial organizations having great resources can aid by convincing proper officials of these corporations that the continued prosperity of our industries depends upon continued progress of research. Since the commercial and industrial establishments of the country reap the larger proportions of the financial profits arising from scientific and technological work, these establishments should contribute liberally to the support of research.

Engineering works, public, corporate, and private, frequently involve studies of special problems or in themselves constitute full-sized experiments, which could be made to yield important data for general technical use. Sometimes the engineers in charge do not perceive the opportunity, not having been trained in research work. More often the possibilities are realized, but means, men, and time are not

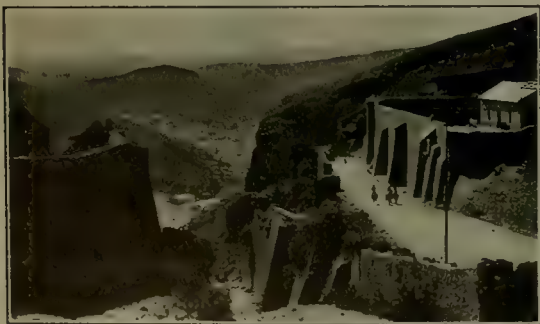
available because of the urgency for completing the project with a minimum expenditure in the shortest practicable time. Occasionally experimental work is undertaken in accordance with a well-conceived plan as a necessary or desirable adjunct to the main operation. In such cases the exigencies of the main operation sooner or later interrupt the experimental work; or the men who have it in hand leave the force; or the information is gained, but never written up; or the statement is buried in some report of limited circulation; or greater familiarity with research methods and a broader conception of the problem could, with small additional expense, have secured much more valuable results and have made them more generally useful.

The services described in the foregoing paragraphs, and many others could be performed by Engineering Foundation, if adequate funds could be placed at its disposal. The Foundation does not plan to build laboratories and conduct research work directly, but rather to stimulate, co-ordinate, and support research work in existing scientific and industrial laboratories, co-operating, insofar as may prove advantageous, with the National Research Council.

Charles F. Rand, 71 Broadway, New York, past-president of United Engineering Society, and of the American Institute of Mining and Metallurgical Engineers, was elected chairman of Engineering Foundation on March 19. With the collaboration of Mr. Swasey, Mr. Rand is actively seeking additions to the endowment fund which will swell the total to at least a million dollars in the near future. Mr. Swasey's gifts amount to \$300,000. The office of Engineering Foundation is in Engineering Societies building, 29 West 39th street, New York. Further information may be had by addressing this office or the chairman. A booklet giving an account of the Engineering Foundation and its work will be mailed upon request.

CLIMBING HILLS AT PACHUCA, MEXICO

The steepest grade in Mexico used for commercial purposes is 'El Bordo', a road approximately two miles in length and running on the edge of a mountain to the El Bordo silver mine, operated by the Santa Gertrudis company at



The Old Mines of Pachuca

Pachuca. The road referred to has an average grade of 14½% with two stretches each exceeding 19%, and is replete with sharp difficult turns. It was on this road that the Duplex 4-wheel drive truck demonstrated its hill-climbing-plus-hauling ability a few weeks ago. On the first morning the truck was loaded with two tons of cement, and made the top without difficulty. The load was increased on the second trip to the total carrying capacity of 3½ tons, and the run was completed with equal facility. The mining company then suggested that an even larger load be tried, and, although it was a clear case of overloading, 8630 lb. of cement was placed on the Duplex and carried to the top of the hill apparently as easily as the first load of two tons.

The ascent was made in 44 minutes. Upon arrival at the top the radiator was sufficiently cool to allow bare hands to be placed on it without discomfort. The spring deflection with the 4-ton load was 1½ in. on the front, and 3 in. on the rear.

Accompanying the data pertaining to the 'El Bordo' demonstration is a table describing the profile of the road, furnished by C. A. Lantz, manager of the Santa Gertrudis. Space does not permit its reproduction here, but a reading of it reveals grades actually as high as 21%, and approximately twenty curves in 7886 ft. of road traversed. This table—a copy of which can be obtained upon request—proves that every care was exercised to obtain absolute authenticity in every phase of the demonstration, and that Duplex performance was out of the ordinary. A further demonstration was effected for the Real del Monte on its steepest grade. This is a mountain road, nine miles long, with grades ranging from 4 to 14%. The load carried was four tons of iron balls and the trip was made without incident, except for passing another 5-ton truck with a 2-ton load.

COMMERCIAL PARAGRAPHS

At a recent meeting of the board of directors of the Wellman-Seaver-Morgan Co., John A. Penton, president of the Penton Publishing Co., was elected a director to fill the vacancy caused by the death of Samuel T. Wellman. Mr. Penton's intimate knowledge of the iron and steel trade, his wide acquaintanceship with prominent people in all lines of industry in this and many foreign countries, and his keen insight into business matters will make him a valued co-worker on the board.

The Booth Electric Furnace Co., Chicago, reports a number of additions to its sales and engineering staff. B. G. Tarkington, formerly industrial heating engineer with Hodenpyl-Hardy Co., is at the Chicago office in charge of district sales. The Buckeye Products Co., 919 West 5th St., Cincinnati, who has charge of sales in the Cincinnati territory, has placed D. E. Carpenter, formerly of the Detroit office of the Westinghouse Electric & Manufacturing Co., in charge of sales of Booth furnaces in that district.

The Bridgeport Brass Co. makes all its brass in electric furnaces, and in this development it has been a pioneer. A recent attractive book describes and illustrates in detail the art of brass-making dating back hundreds of years, leading up to the most modern practices as in use in its plant, including the electric casting-shop. The important steps in the making of tubes, sheet, rods, and wire are also shown. It discusses the properties of brass as affected by composition, cold-working, and heat-treatment, with the idea of assisting engineers in drawing specifications. In the compilation of this pamphlet the company has deviated from the conventions and traditions of the brass industry by making an open book of the practices and processes of brass making and the result is an interesting and valuable publication.

The Dodge Sales & Engineering Co. distributes the products manufactured by the Dodge Manufacturing Co. and the Dodge Steel Pulley Corporation. Its recent catalogue 'D-20-Chain' is believed to be the most complete and comprehensive publication obtainable on the subject of 'Industrial Chains for Elevating, Conveying, and Power Transmission'. The book is compiled and arranged for the convenience and benefit of the engineer and of the operator. No attempt has been made to list a complete line; but rather to show the various types and their general application in various kinds of service. The principles of design, the choice of material, and the conditions of operation are detailed, and the specifications necessary in the purchase of this class of equipment are discussed. The catalogue is a valuable handbook.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Deseray Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JUNE 5, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page		Page
EDITORIAL		ARTICLES	
NOTES	819		
THE MEXICAN MELODRAMA	821	THE SPASSKY AND ATBASAR COPPER MINES IN SIBERIA—II	
Carranza's tragic end. Review of Mexican rulers and governments during the last ten years. The articles by Ibañez and the farcical aspect of Mexican politics. Character sketches of Carranza, Gonzales, Bonillas, Barragan, and Obregon.		By J. Mackintosh Bell.....	825
CONCERNING GOLD	822	History of the region. Development of the mines. Geologic features of the deposits. Sulphide and oxidized ores. Methods of mining.	
Persistence of fallacies. A keynote address at a convention at Spokane. Colonel Kennan's misstatements on the subject. Gold is still the standard and a free market for gold still survives in the United States. Purchases of gold and sales to the Mint. The yarn about the smelters buying at \$20 and selling for \$35 per ounce is nonsense.		MR. GOVETT ON THE GOLD PROBLEM.....	830
DISCUSSION		'Free trade' has not operated in respect to gold. Gold as actual backing for currency is a farce. Its part in maintaining the exchange rate. How it works. Silver. Government efforts to 'peg' the rupee. The moral.	
A MATTER OF GEOGRAPHY		FROTH-FLOTATION AT BROKEN HILL	
By E. Vernon Morgan.....	823	By C. C. Freeman.....	833
Kingman, Arizona, and the Golconda mine.		Theoretical considerations are of minor importance. Experimental work. 'Differential'; 'preferential'; 'selective'. Controlling the degree of intensification of conditions. The things that effect intensification. Application at Broken Hill. Equipment used. The 'Cascade Pots'. Scope of the process. Oxidized ores.	
THE CASE OIL-FIRED ASSAY-FURNACE		NOTES	
By M. J. Sherlock.....	823	STRONTIUM	838
Experience different from that of F. Borzynski. How to manipulate the furnace for cupellation.		DEPARTMENTS	
ASSAY OF PLATINUM		REVIEW OF MINING.....	839
By C. W. Davis.....	823	THE MINING SUMMARY.....	847
Satisfactory results obtained with fire-assay methods.		PERSONAL	848
ENGINEERING ACTIVITIES OF UNIVERSITIES AND GOVERNMENT BUREAUS		THE METAL MARKET	849
By A. B. Parsons.....	824	EASTERN METAL MARKET	850
The plan of the Massachusetts Institute of Tech-		INDUSTRIAL PROGRESS	851

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.



The Master Surgeon of Industry

JUST as surgery performs miracles of reconstruction on war-broken bodies so does Oxweld achieve the seemingly impossible in the industrial field. Broken and cracked metal parts which formerly caused days and even weeks of enforced idleness are now remade *on the spot in a few hours*. Worn surfaces are built up—strong as ever.

Wherever metal machines are used oxwelding will save many times its cost in time and money

In over 50 cities are Oxweld Engineers ready to apply the vast fund of Oxweld cutting and welding knowledge to your individual problems.

Write, phone or telegraph to any of the addresses below for immediate attention from the nearest Oxweld Service Center.

OXWELD ACETYLENE COMPANY

Newark, N. J.

Chicago

Los Angeles

World's Largest Maker of Equipment for Oxwelding and Cutting Metals



T. A. RICKARD, . . . Editor

WE continue to receive propaganda on thrift and the buying of Liberty bonds from the Savings Division of the U. S. Treasury Department. Have these gentlemen no sense of humor? How can their solicitations be effective so long as the Treasury Department continues to carry 38,000 employees on its payroll and wastes paper, which is expensive now, on lucubrations that no one reads? What is the use of recommending Liberty bonds when they are allowed to fall below 90, after being described emphatically as the premier investment security in the world? Gentlemen, set an example of thrift by ceasing to squander the national income.

UNDER 'Positions Wanted' there appears an advertisement from a mining engineer offering his services as a flying-man to any mining company needing one like himself. Our young friend saw service with the Army and has read in the daily papers that aeroplanes have been used to reach remote mines, in Alaska and elsewhere. We await with interest the result of his offer. Meanwhile we note the issue, by the U. S. Bureau of Mines, of a paper on the 'Use of Airplanes in Mine-Rescue Work', by Mr. F. J. Bailey, who concludes that they can be used to advantage for this purpose in regions, such as the Middle West, where the surface is comparatively level.

NO recent appointment to an important administrative position seems to us to be so entirely satisfactory as that of Mr. John C. Merriam to the presidency of the Carnegie Institution, in succession to Dr. Robert S. Woodward. Dr. Merriam is dean of the faculties and professor of paleontology in the University of California, but he has been serving for some time as chairman of the National Research Council, in which capacity he has proved his keen intelligence and high character. As a splendid exponent of the highest ideals in American science, it is most appropriate that he should be placed at the head of the Carnegie endowment, where we hope he will find an unfettered opportunity to stimulate research of the most useful kind.

IT is well to get the point of view of others. We are glad therefore to publish a speech by Mr. Francis A. Govett on the status of gold, as reported in the columns of the 'Financial Times', of London. On the occasion of this public utterance Mr. Govett was presiding at the annual meeting of the Ivanhoe Corporation, a company owning a famous gold mine at Kalgoorlie, in Western

Australia. In London Mr. Govett is the leader of a mining group with which Mr. Hoover used to be connected; he is a gentleman that takes himself pretty seriously, but he succeeds in winning the attention of serious people, and he has won deservedly a reputation for sagacity and integrity. His remarks on one of the principal problems of the day are well worthy of respectful consideration.

SENATOR PITTMAN has performed a public service in correcting a misapprehension in regard to the purchase of silver by the Mint. It has been stated in sundry papers that the Mint will accept only fine silver under the Pittman Act. This is incorrect. The Mint will accept ordinary bars of bullion as they come from mills and smelters, as it has done heretofore. If the bullion contains a one-thousandth part of gold, it is then regarded as a deposit of gold; and the silver in a gold deposit, no matter how small or large it may be, is paid for at the rate of one dollar per ounce for each ounce therein contained of so-called pure silver, that is, 1000 fine. If the bullion contains no gold, but contains 601 thousandths of silver, it will be accepted as a silver deposit and be paid for in the same way. The expression used in the Act, "one thousand fine", measures the price paid for the silver in bullion, but does not control the purity or kind of bullion receivable by the Mint. A small charge, for parting the silver from other metals, is made, as is usual at the smelters. The Director of the Mint has issued instructions in accord with this interpretation of the Pittman Act. Under the misunderstanding it has been charged that only refiners could obtain the benefit of the Act. This is quite wrong; on the contrary, under the Act it becomes unnecessary to send silver to the smelters and refiners.

CONGRESSMEN continue to flirt with the soldier bonus. Flirtation is defined as attention without intention. Everybody at Washington knows that nothing will be done in this matter during this session of Congress, but the various proposals seek to catch the vote of the soldiers in the coming elections. The Government is piling up a deficit of three to four billion dollars per annum, besides three-quarters of a billion into railroad losses and half a billion into Shipping Board expenditures, not to mention two-thirds of a billion as interest on the public debt. This is no time for further extravagance, which only belittles and commercializes the services of our brave boys. It is time the politicians stopped

fooling them. On May 19 the Secretary of the Treasury declared his opposition to any bonus legislation, "however financed". He stated that it would be "highly unfortunate" if any new obligations were placed upon the Treasury, and suggested that it would be wise for Congress to seek out additional sources of revenue to meet current government expenses.

SIBERIAN gold is the subject of an editorial in the 'Morning Scream'. It discusses the effect of finding gold "in quantities" in north-eastern Siberia, particularly as a stimulant to Japanese aggression. The reported discoveries, it is said, would suffice "to change history in this part of the East, as gold finds have changed history elsewhere, beginning with Colchis". The range of classic lore exhibited by this reference is impressive, but the editor would have done better to substitute the North Fork of the American river or the Yuba. It might have been less grand, but it would have been more significant. We are told by him that north-eastern Siberia is "not an attractive country to stampede into". It is not. "There are no towns, no roads, no bases of supply." That is profoundly true. "The existence of placer gold on the Siberian side of Bering strait has long been known." Yes; a similar statement can be made concerning the gold in the sea. "Placer mining is not a game that lends itself to poaching." It is, if the gravel be rich enough; but, as has been recorded in these columns many times during the last twenty years, the evidence available indicates that the alluvial deposits of Nome do not extend across Bering strait and that north-eastern Siberia is not a country rich in gold.

GOOD citizens, without distinction of party, must regret the unseemly squabble between Admiral Sims and Secretary Daniels. The washing of dirty linen in public is never an edifying performance. We note, however, one remark by the Secretary of the Navy that deserves to be remembered. He describes Admiral Benson as "all-American, neither 'pro' nor 'anti' with reference to any other country". There he struck a true note of genuine patriotism. In times of peace the less appeal is made to prejudices against European nations, the better it is for genuine Americanism. A propaganda either for or against a foreign country has a disintegrating effect on the national spirit, particularly of those who themselves or whose parents came from across the sea, because such appeals are addressed to feelings that are non-American. The bitter anti-British propaganda of the Hearst papers has a bad effect, not only because it stirs up ill-will toward a country with which we have many friendly ties, but because it evokes the sympathies of one group and the antagonism of another group, provoking enmity between them and forcing an alignment upon non-American issues, thereby hindering the process whereby those of foreign birth are developing into true Americans. The great problem of the United States is the absorption of its alien elements into a composite nation in complete sympathy with its own traditions.

That process is hindered every time that various groups among our people are asked needlessly to take sides in a controversy involving the country of their origin or its neighbors.

WE are informed that henceforth a geologist is to be attached to the San Francisco office of the U. S. Geological Survey, in collaboration with Mr. Charles G. Yale, who has charge of the statistical work of the local office. The Director of the Survey plans to increase the usefulness of his bureau to the Pacific Coast, including Nevada and Arizona, by this innovation. The duty of the new appointee will be to visit promptly any recently discovered mineral deposits in these States and to re-visit the more important of the older districts as often as is practicable; it is proposed also to have strictly geologic data on tap in a manner corresponding with the statistical and other information that Mr. Yale has been furnishing for years so courteously and efficiently. This, of course, is not meant as an encroachment on the field of the State Mining Bureau of California or the analogous bureaus in the other States; the resident geologist of the Federal Survey will supplement, not duplicate, the work of the State organizations; he will co-operate with them whole-heartedly. It is known to the friends of Mr. Yale that he will be seeking retirement before long; he has earned a rest, but the Survey is loth to let him go, and it is extremely desirable in the public interest that his work should be lightened and that he should be enabled to give the benefit of his accumulated experience to a younger man before seeking the leisure to which he is entitled. We hope that this new move will postpone that event, for the Survey office without Charles G. Yale would lose much of the character that has made it valuable and attractive to those engaged in mining on this Coast.

WALKERVILLE is a victim of circumstance, according to the irreconcilables who have made their homes in the little town for more than a generation. Except for the accident of its situation just around the hill from Butte, Walkerville would be a thriving town today, as it was when Butte was merely a row of shacks inhabited by a few miners who washed gold from the diggings that fringed what afterward became known as Anaconda hill. Later when Butte, on account of its more favorable site, began to grow, the Alice mine at Walkerville was the mainstay of its industry. The story is told how John Noyes, owner of sundry real estate, received a tip from Marcus Daly, who was in charge of the Alice. On this particular occasion when Noyes waylaid him in order to learn, confidentially, the latest development in the mine, Daly mournfully shook his head, whereupon Noyes, assuming that the future was not rosy, sold a corner lot at the intersection of Main and Broadway for \$12,000, and tried in vain to dispose of other property. As a matter of fact, Daly had been joking with his friend, for the next day the report of the finding of a wonderful new vein was made and Butte real estate began to boom. The story goes that Noyes would not speak to Daly for a

year. The silver ore in the Alice, the Lexington, and other mines was remarkably rich, and for years these mines thrived and Walkerville flourished with them. Then came the collapse in the price of silver, and the subsequent closing of practically all of Walkerville's mines. Much of the population left, but the town itself survived. It still elected its own mayor, and had its own lodges and its own clubs. The sons of the earlier generation walked over the hill to the Speculator, the Badger, the Elm Orlu, and the Black Rock; they went to Butte to spend their money, but they still lived at Walkerville. Now the Moulton, the Goldsmith, and the Alice are showing the effect of high-priced silver; they are the scene of active mining. Lessees are at work, in shallow surface pits, on old dumps, and in the underground workings. Everybody seems prosperous. But Walkerville is handicapped by propinquity to the country's only 'mining city'. Every 20 minutes an electric car toils slowly up the hill and symbolizes the bonds that make it impossible for the old town to rouse from the lethargy of three decades.

The Mexican Melodrama

Another act is over; exit Carranza. The grim play of Mexican politics is sometimes a farce, but always ends with a tragic note. In the dark hours of May 21 the seventy-second Mexican government in 99 years came to a bloody finish when Venustiano Carranza was murdered by traitors in his own camp at Tlaxcaltenango, when making an effort to reach the coast north of Vera Cruz. It may be well to recall the other acts in the Mexican melodrama, which, like a Chinese play, seems to be a continuous performance. On May 25, 1911, Porfirio Diaz resigned as President of the Mexican republic and fled to Europe. He had ruled the country for 34 years and was 81 years old. Francisco Madero, the leader of the revolution, an amiable reformer, was duly 'elected' President. On February 22, 1913, he and Piño Suarez, the vice-president, were assassinated by the soldiers of General Victoriano Huerta, who became President. A new revolution was started by Carranza, then Governor of Coahuila, to avenge the death of Madero. The opposition to Huerta was joined by Francisco Villa, a bandit of the dirtiest type, but a good fighter. Villa defeated Huerta at Torreon. Carranza assumed the title of First Chief of the Constitutionalist Party and finally succeeded in driving Huerta out of office and out of the country in July 1914. Three years later Huerta died a natural death, but not in Mexico. The victor assumed the presidency, only to find his government flouted by Villa, Zapata, Orozco, and other insurrectionary chiefs. On September 23, 1914, Villa declared war on Carranza and drove him out of Mexico City to Orizaba. Then Alvaro Obregon came into prominence as Carranza's best general; at the battle of Celaya, in which he defeated Villa summarily, he lost his arm by shell-fire. Thanks to Obregon, the power of Carranza was consolidated and on October 19, 1915, the government of the United States recognized his administration

as the *de facto* government of Mexico. On March 11, 1917, Carranza was 'elected' President. Already he had shown pro-German sympathy, and the publication of the Zimmermann note, which just preceded the declaration of war against Germany by the United States, indicated clearly his unfriendly attitude to this country. He endeavored to prevent the production of oil in the Tampico district and issued a series of decrees hurtful to American interests in Mexico. When his term of office approached its legal end, this year, he attempted to dictate the election of Ygnacio Bonillas, formerly Ambassador to the United States, as his successor. It was claimed by General Obregon and other candidates for the presidency that Bonillas was a mere deputy, meant to occupy the office while Carranza retained control and prepared to make some shift that would return him to power. When about to be arrested by Carranza's orders, Obregon started a revolution, which broke out first in Sonora under the leadership of General Elias P. Calles. On May 8 Carranza fled from the capital in a vain effort to reach Vera Cruz, but was blocked by troops under General Pablo Gonzales, who then joined the new revolution, which found general support all over Mexico. Two weeks later the dead body of the First Chief was brought back to Mexico City and buried among the poor in the Dolores cemetery. On the same day General Adolfo De la Huerta became President *ad interim* and postponed the presidential election from July 4 to September 5. Meanwhile General Gonzales withdrew his candidacy, so that General Obregon became the acknowledged leader of the successful revolution, which, like a primary election, marked him as the head of the seventy-third government since Mexico gained her independence from Spain in 1821.

So much for the sombre side of the story. Now comes a celebrated writer, Señor Blasco Ibañez, and develops the humorous aspects of this moving picture of graft and murder, politics and pillage, bombast and brigandage. In the Spanish novelist's scenario Venustiano Carranza appears as a frockcoated *ranchero* of dignified mien, with a flowing beard and a smattering of law, the country gentleman *muy simpático* of his friends, the *viejo barbon* of his enemies, and the 'Don Pomposo' of the caricaturist. He rose to power by making use of the military leaders and he fell when he quarreled with them over the spoils. First Villa and Angeles, then Obregon and Gonzales refused to play the old man's game, leaving him for Chief of Staff a military Adonis, 'Juanito' Barragan, remarkable for his sartorial splendors and a graceful hospitality to ladies of the stage. Carranza's nominee for the presidency, the ambassador, Ygnacio Bonillas, was made known by an extravagant campaign of posters and his nickname, *Flor de Te*, the Tea-flower. Pancho Villa, a murderous blackguard, a butcher and a brigand, has had his side-show of fighting and looting while the other *dramatis personae* have occupied the centre of the stage. Occasionally he interrupts the main action of the play. The scholarly Felipe Angeles is caught by the Federal troops and dies a gallant

death with his back to the wall. Don Pablo Gonzales, prudent and respectable, watching which way the cat jumps, an opportunist *in excelsis*, quits Carranza at the critical moment and assures the success of the revolution. Not caring to endanger his skin, he declines to compete with Obregon in the 'election' that is to give formal sanction to the recent *bouleversement*. Alvaro Obregon is a veritable cinematic hero, a gallant soldier minus an arm, a flamboyant orator, a picturesque *poseur*, the logical victor in the topsyturvy of militaristic misrule. Good-naturedly wicked, brutally gay, and rustically frank, he twirls his upturned moustache and smiles upon the scene, which, at the moment, looks fair to him. The chick-pea dealer of Sonora enters the palace of Montezuma. *Viva Obregon!*

Concerning Gold

Many queer notions prevail in regard to the price of gold, despite the efforts of technical and other papers to inform the public on the subject. Bankers and public men of responsible character have tried to dissipate sundry fallacies that stick like burrs in the minds of the average man, yet the old yarns survive apparently with unimpaired credibility. For example, we have received no less than four copies of a "keynote address" that was to have been delivered by Colonel Chester T. Kennan before a New Gold Standard Convention at Spokane on May 19. Whether this address did prove the keynote to the projected convention we do not know, but we deplore the waste of good paper at a time when a shortage of that product is so acute, particularly as the gentleman who squandered it for the purpose of personal publicity is not one whose opinions on an intricate problem are such as to merit confidence. His address is as full of glaring blunders as a sieve is full of holes. "During the last five years", he says, "gold has not been in circulation as money or medium of exchange in any part of the world." This is not true; there has been a plethora of gold as a medium of exchange in several countries, notably Norway and Holland, not to mention the United States, where gold is still performing its customary function. The Colonel—where did he get the title anyway!—asserts that "we have no common measure or standard of value now, all nations have suspended or repudiated gold payments". This is contrary to fact, as can be ascertained by anybody who will take the trouble to do so. If, for example, the Colonel desires to turn \$10,000 into gold, he can obtain from his banker a draft on a Federal Reserve bank for that amount, and the Federal Reserve bank will give him the equivalent in gold coin. The Federal Reserve bank is not compelled to do this, but it will pay him in Federal Reserve notes, which the Treasury at Washington must redeem at par, as is printed on the notes themselves. Next the Colonel makes the statement that "no government dares to pay out its gold now at the old standard price per ounce". The Government of the United States will sell gold to Mr. Kennan or anybody else at the rate fixed by law, namely, \$20.67 per ounce. That is exactly what jewelers and other

manufacturers are doing every day. The Mint, however, according to law, does not sell gold in the form of bullion in amounts less than \$5000 at a time; similarly the Mint will buy bullion in amounts of over \$50, these restrictions being matters of convenience. The Colonel says that what we need is an "honest" dollar; he asserts that our dollar should be "stabilized". He will find that the American dollar is today the most stable monetary unit in the world and that other units are being measured in terms of it. Next the Colonel talks a lot of nonsense about the ex-Secretary of the Treasury and a "swindle" perpetrated by the "McAdoo syndicate". Mr. Kennan has the habit, as we are aware from communications received and rejected by us, of making wild statements reflecting upon the honor of public officials, such as the heads of Federal departments. He has written a lot of drivel concerning the U. S. Treasury in his "keynote" address and he ought to be ashamed of it. Next we note that he claims acquaintance with a broker "who was recently hired by a Seattle firm to buy placer gold in the Blue Mountains district at \$33 per ounce, and the firm was to give him \$2 per ounce commission for buying it, which would make it net the firm \$35 per ounce". What is still more strange, the broker failed to make his purchases because "other buyers, of whom there were a dozen or so in the district, were paying around \$35 per ounce". This is pure buncombe. His broker friend can buy gold from the U. S. Mint for \$20.67 per ounce, and he can sell it to the Mint for \$20.67 per ounce. The notion that gold is selling for \$35 per ounce anywhere is a mare's nest. If Mr. Kennan sends his gold to London he will obtain for it 107 shillings or thereabouts, the price varying daily. This price, as compared with the normal of 84.95 shillings per ounce, will represent a premium of about 20% in *shillings*. When he returns to New York and turns his shillings into *dollars*, he will find that he must pay a discount equal to the premium he received in London; in other words, the premium on gold measures the depreciation of British paper currency in terms of American dollars. When gold is selling at 107 shillings, the pound sterling is exchangeable for about \$3.85, instead of the normal rate of \$4.86. Mr. Kennan asserts that the banks are "selling the people's gold coin to foreign countries at about \$35 per ounce and pocketing the profits, i. e., all over \$20.67 per ounce". This silly talk is followed by a similar statement that "the smelters of the United States have been and are paying the miners of smelting ores only for 95% of the gold contained in their ores and only \$20 per ounce for that 95%; but the smelters are selling that same gold at the market price, presumably about \$35 per ounce, and pocketing the difference". Well, we hold no brief for the smelters, they are in the hands of bold bad people, not Sunday-school teachers, of course, but Mr. Kennan is circulating a stupid lie when he makes the above assertion. Indeed, he seems to have such a sacred regard for the truth as to use it sparingly. At the best, he is an ignorant man who is fooling himself and others; at the worst he is a public nuisance.

DISCUSSION



A Matter of Geography

The Editor:

Sir—In your issue of May 8 occurs an interesting article entitled 'The Contract System in Mines', by E. Hedburg. The article, however, in locating the Golconda mine at Kingman, suggests some geographic conditions rather difficult to establish, and indicates recent movements of the earth's crust somewhat startling to those familiar with this neighborhood. It can be safely stated that, in 1910 and thenceforth until April 18, 1920 (when the writer last visited the property), the Golconda mine was located some 25 miles northerly from Kingman and about 7 miles from Chloride; and that, if it has changed its position and located itself at Kingman, this event must have taken place within the last 30 days.

The writer craves indulgence in this very mild criticism, since it is only prompted by the complaint of engineers visiting this interesting section, to the effect that many of the mines they come to see are described in various journals as being located "at Kingman"; whereas, in fact, Kingman has no mines at all, being merely the local goods-distributing station on the Santa Fe railway for Oatman, Chloride, and the various mining camps off the main railroad line.

E. VERNON MORGAN.

Kingman, Arizona, May 18.

The Case Oil-Fired Assay-Furnace

The Editor:

Sir—I note the article by F. Borzynski on this subject appearing in your issue of May 15. As I am at the present time operating three furnaces of the type he describes in his article, I wish to comment on same. I differ with him on some of his statements or suggestions regarding the operation of the furnace.

Some time before I had operated these furnaces I had heard statements by some operators who claimed that they could not be worked satisfactorily on cupellation. In my first experience I operated the furnace as does Mr. Borzynski on fusions. In cupellation I could not hold the heat with the door open, and as closing the door is not practical in cupellation I decided to try another system of operating the dampers and front baffle; this system I am now using. I found that the front baffle, with the edge toward the flame, had a tendency to throw the flame upward at about the centre of the muffle and that, when the door of the furnace was open, the muffle cooled down in front and that it was impossible to cupel with the door open. The front baffle being loose I changed it so that the

broad side was toward the burner. The flame then hit the centre of the broad side of the baffle and I found that it gave a very even distribution of the flame around the muffle and the front part of the muffle was nearly as hot as the back. I can now hold the heat in the front part of the muffle, with the door open, very nicely for cupellation. I then set my dampers half-closed and do not move them for either fusion or cupellation. The only time I touch the dampers is in changing muffles. The only parts that I regulate during the time of operation are the oil and air-valves. I have had the very best success on cupellation and fusion in these furnaces.

In reference to Mr. Borzynski's statement on cupellation in cracked muffles, I wish to state that when using cracked muffles with the conditions of operations as above, the flame or gas that may come through the muffle does not interfere. I am also running silver ores that must be feathered during cupellation and I run 33 cupellations in a furnace and feather them perfectly.

In reference to Mr. Borzynski's statements regarding the slot in the door of the furnace and the 'boss', which he calls a "draft-regulator", I find that this 'boss' has nothing whatever to do with the draft regulation on these furnaces. The slot on the furnace-door is something I never use in my operations. I have perfect control of the furnaces with the oil and air-valves for lowering and raising the heat, with the door of the furnaces wide open during cupellation.

M. J. SHERLOCK.

Butte, Montana, May 19.

Assay of Platinum

The Editor:

Sir—In an article published in your issue of December 20, 1919, Mr. K. C. Laylander makes a statement to the effect that the use of an electric furnace is necessary for consistent results in the determination of platinum by means of the crucible assay. In this connection he writes: "Let the experimenter who doubts this take a known weight of pulverized platinum and introduce it in an ordinary assay charge, and compare his recovered metal with the original amount."

While investigating methods of platinum analysis, in examining the recovery of finely divided or colloidal platinum by fire-assay methods, results were obtained which were distinctly different from those secured by Mr. Laylander. Weighed amounts of platinum were added to regular crucible-charges consisting of silica, litharge, sodium carbonate, borax-glass, charcoal to give a 30-gm. button, and 0.05 gm. of silver chloride. The

platinum was introduced in four ways: the first was to wrap a small piece of platinum in lead foil and add to the charge; the second method intimately mixed finely divided platinum (obtained by boiling a solution with formic acid to precipitate the platinum) with the charge; in the third, sodium silicate was added to a solution of chloro-platinic acid, hydrogen sulphide added in the cold to form a colloid, and then ammonia added to form a gelatinous precipitate, the mixture being dried and mixed thoroughly with the flux; the fourth method was the same as the third, except that no hydrogen sulphide was introduced.

The fusions were conducted in a gasoline furnace at a temperature of about 1200°C., and in all cases the platinum was recovered without difficulty, as shown below.

Method of preparation	Platinum added Mgm.	Platinum recovered Mgm.
First	0.52	0.51
Second	0.32	0.33
Third	0.50	0.49
Fourth	0.35	0.35

The fact that such reputable assayers as Abbott A. Hanks of San Francisco and W. L. Piers of Denver have obtained similar results, being able to recover known weights of finely divided platinum when added to a regular crucible-assay charge without the use of an electric furnace, would indicate that excessive temperatures are not required for the determination of platinum by means of fire-assay methods.

C. W. DAVIS.

Golden, Colorado, May 3.

Engineering Activities of Universities and Government Bureaus

The Editor:

Sir—I have read the report, published in your issue of May 15, by the Mineral Resources section of the Commonwealth Club. Having taken some interest in the plan of the Massachusetts Institute of Technology, I note particularly the brief comment in the report regarding it. Apparently the committee fears that neither the contracting companies nor the Institute itself will find the scheme advantageous. As is pointed out, however, the test of time will be required to answer this point satisfactorily. Apparently co-operation for mutual benefit is the keynote of the plan, in which 200 companies, whose activities require technical consultation, among them the Miami Copper Co., are already participants. In consideration of a substantial annual retainer, the Institute undertakes to give access to its library and files and to arrange for conferences on problems pertaining to the operations of the contracting company; to assist in finding suitable men for doing special research and for filling permanent positions not only from among its undergraduates and alumni but from among specialists and consultants in general; and to advise as to the best means and place for conducting technical investigations and research, either in its own laboratories or elsewhere. The directors emphasize the fact that they make a strictly

business arrangement by which the company pays well for a definite service that is always available. They recognize, doubtless, the psychology that causes us to depreciate what we get for nothing, or conversely, leads us to value the things that cost us something. It would seem that if the professors and instructors of an institution for technical education are to train and fit young men for useful careers, which is their real function, they must come in contact with the actual application of their science to productive industry. Co-operation with the executives of corporations in the solution of practical problems ought to prove helpful. The student will have the incentive of knowing that some, at least, of the tasks at which he works are concerned directly with the business of actual production; and he will be stimulated to do his best by the knowledge that there is a prospect of material reward in the shape of lucrative employment. The same hope of definite future advantage will influence the return of graduates for further research. This is in accord with the universal tendency to lengthen the period of training for technical students. At first thought there may appear reason for antagonism or resentment on the part of the practising consultant because of an apparent poaching upon what he has come to view as his special preserve. However, on more careful consideration, he will find probably that the advantages afforded him more than compensate for any apparent competition in his professional activity. The Division of Industrial Co-operation and Research, established to direct this department, states that it neither wishes nor intends to confine its scope to the personnel or facilities of the Institute, but rather aims to select for its client the best individual or organization for performing any particular investigation. Doubtless a large concern like the Miami company will maintain its regular staff of consultants; but they will have available, besides the thoroughly equipped laboratories of the Institute for special investigations, a convenient and organized source of advice as to where, and from whom, desired information can best be obtained. We presume that the practising engineer himself will have occasion to make use of the library and files of the Institute, which should rapidly increase in value as a result of the present plan. The accurate data on any given subject will accumulate rapidly and will be more complete and comprehensive than could ordinarily be found in the office of a firm of engineers. One of the greatest needs of industry today is to utilize the reservoirs of science already available; this is the purpose of applied research work, and the Technology plan seems to be a step toward efficient and organized research.

San Francisco, May 19.

A. B. PARSONS.

APPROXIMATELY 101,000,000 lb. of copper was sold in the United States in April. This compares with 320,000,000 lb. in March, 89,000,000 in February, and 239,000,000 in January, making a total of approximately 750,000,000 lb. sold since the first of the year. Production in the same period was approximately 550,000,000 pounds.

The Spassky and Atbasar Copper Mines in Siberia—II

By J. MACKINTOSH BELL

INTRODUCTION. The copper deposits of Djes Kazgan, identified with the mines of Atbasar, are situated in the government of Akmolinsk, in Russian Asia, about 290 miles a little west of south from Atbasar village, and some 510 miles from Petropavlovsk on the Trans-Siberian railway. Communication with the mines was formerly maintained over the stage-road from Petropavlovsk through Atbasar, but latterly it has been feasible only across the desert of northern Russian Turkestan to the station of Djou Sali on the Orenburg-Tashkent railway about 250 miles south-westerly. The properties of the former Atbasar Copperfields, now incorporated with the Spassky Copper Mine, include, in addition to the copper deposits at Djes Kazgan, the coal mine at Bai Kanour, 85 miles to the west, and the settlement of Karsak Pai, where the concentrating plant and smelter are situated.

From a historical standpoint, or, possibly more correctly, pre-historical standpoint, the region surrounding Djes Kazgan is one of extreme interest. Ancient roads along which caravans from India and China to European Russia have traveled from time immemorial pass close to the mines, numerous graves covered with piles of stones and containing bronze implements testifying to a people long since departed. But even more remarkable are the old mine-workings around Djes Kazgan itself, where many open-cuts with galleries ramifying therefrom show that a people skilled in mining worked the deposits so long ago that the workings have had time to become filled with waste and mantled by a slow-growing desert brush. The open-cuts vary in size from shallow pits to huge excavations 750 ft. long, 125 ft. wide, and at least 40 ft. deep. Having regard to the simple instruments that were evidently used in the primitive methods of mining, it is evident that the operations, during which such extensive workings were made, must have extended over a relatively long period of time and that many people were busy. Apparently only oxidized ores were mined, but it is estimated that over a million tons of rock was moved containing probably not less than 10,000 tons of copper! Slag-heaps and occasional pellets of metallic copper close to the mines indicate that smelting operations were conducted, while heaps of rich copper ores adjoining piles of much poorer material near water-holes would seem to imply that the ore was concentrated by water before smelting. The fuel used in smelting was probably either kissick or desert scrub.

Who these ancient miners of south-western Siberia were we have no authentic record. They probably came from the south, as the remains of smelting operations lie along the streams in that direction, and, judging by the few fragments of pottery that have been found with designs of a Persian aspect, it may be assumed that they

were an eastern people. The Kirghiz, who have inhabited the steppes for more than 150 years, have no stories of them; the pits give the impression of being untouched for four or five hundred years. The Russians generally describe the old workers as having been Kalmucks, but as this name is applied to so many different types of people in Central Asia, the designation has no significance.

During the middle of the last century, Oulutau, about 50 miles north of Djes Kazgan, from which the Cossacks were eventually driven by the Kirghiz, was a frontier post held by the former as a base against marauding bands from Bokhara, who swept the steppes to the south. It was evidently while quelling one of these disturbances



BRINGING HAY TO DJES KAZGAN

that the Cossacks found the ancient mines, which they brought to the attention of Oushakoff, a Russian merchant-engineer from Ekaterinburg, who had already established copper mining in the region at Yuspensky, about 260 miles east. Oushakoff obtained concessions from the dominant Kirghiz chief of the region in 1850, but no great headway in the development of the mines seems to have been made until his partner, Ryananoff, who had been associated with him at Yuspensky, sent a party of engineers to the property in 1891. They staked a large area, which was held by special Imperial grants until 1904, when the mines were brought to the attention of English capitalists. In 1907 the Atbasar Copperfields, Limited, commenced operations and in 1913 the Spassky Copper Mine, Limited, which was already largely interested in this company, acquired the remainder of the shares.

Development of the Atbasar copper mines under English control proceeded rapidly and large quantities of ore were blocked out. To make this available, the coal mine at Bai Kanour had to be opened up, supplies of

suitable limestone and ironstone flux procured, and concentrators, furnaces, and other smelting plant erected. The site for the reduction works was chosen at Karsak Pai, as it is conveniently placed for all the raw materials, and it has, relatively speaking, a good supply of water. A railway was projected to connect both coal and copper mines with the reduction plant.

Probably the greatest difficulty was the transport. All mining supplies had to be brought hundreds of miles across the steppes from Petropavlovsk or over the shorter but more difficult stretch across the desert from Djou Sali. The climate of the region is not one in which these long treks with oxen, horses, or camels were easy. The summer is long, dry, and intensely hot; the winter equally long and cold. Dust-storms rage occasionally in summer, and blizzards of terrific fury in winter. Rain in summer is scant, but occasionally a heavy downpour for a brief spell deluges the arid hillsides, gouging deep channels where runnels only existed before.

Labor has never been an easy problem, the Russians being fewer in number and less efficient than at Spassky or Yuspensky, whereas the Kirghiz are less organized and apparently less tractable.

Notwithstanding these obstacles, work advanced well until the War broke out. A vigorous building program was in progress. The War took men away from the mines, interrupted transportation, raised the cost of supplies, and hindered every endeavor. Meanwhile new capital became necessary, but it was precluded by the Treasury restrictions in England from being available. The company, consequently, had to turn to its current profits, derived from the Spassky, in order to continue operations. The impossibility of obtaining ordinary supplies, such as rails, further embarrassed the management and all sorts of devices had to be adopted by the engineers in charge. Thus, in order to transport the machinery required for the mines and smelter from Djou Sali, a temporary line of railway was built, the supply of rails available being 9 miles long and the train carrying supplies $1\frac{1}{2}$ miles long. When the train had advanced as far as possible, the rails from behind were lifted and used for the next relay. No less than 500,000 tons was transported in this way between the outbreak of the War and the first year of the revolution. Trouble with the Kirghiz delayed the caravan and for two winters it was parked in the snow, but eventually arrived at Karsak Pai with the loss of but a few bits of timber and a number of tarpaulins.

The evil influence of the revolution does not seem to have been felt at Djes Kazgan, Bai Kanour, and Karsak Pai so soon as elsewhere, but in time it worked its way even to these remote settlements, paralyzing the strenuous efforts of the management and in time closing the mines and smelter, before the latter had commenced to produce.

REGIONAL GEOLOGY. The most interesting rocks in the portion of Central Asia under review are a great sedimentary series of Permo-Carboniferous age. Near Bai Kanour these overlie two groups of metamorphic rocks: (1) chlorite schists and schistose porphyrites; (2) slates and cherty quartzites with limey layers.

The exact relationship of these two groups to each other is not clear, but it is thought that certain of the schists of the first group are merely the more metamorphosed equivalents of the definite sedimentaries of the second group, while others are unquestionably highly altered volcanic or other igneous rocks. Other varieties of schist occur, and banded ironstones, resembling those of North America, are found enclosed therein, notably near Karsak Pai. The two groups are cut by granite, often porphyritic, and by porphyries. Serpentine is found that have not been exactly correlated to the other rocks. Quartz veins, in places exceedingly rusty and containing gold and silver, are of widespread distribution within the schist.

Southward, the Permo-Carboniferous sedimentaries and the underlying rocks, which are all more or less disturbed, are overlain by a series of white and red clays with interbedded coherent sandstone. These continue as far as the Aral sea; they are marine Tertiaries.

The Permo-Carboniferous series consists of four more or less distinct groups, measured from the lowest as follows:

1. Conglomerates, sandstones, and arkoses.
2. Chert and limestone.
3. Conglomerates, sandstones, and shales with carbonaceous seams.
4. Sandstones, conglomerates, shales, thinly bedded limestones and cherts.

With the first group are associated important deposits of iron and manganese, about 20 miles north-west of Djes Kazgan; the second contains the thickest and most extensive beds of limestone known in the locality; in the third group coal seams may be expected; in the fourth are the copper deposits of Djes Kazgan.

TOPOGRAPHY. In contradistinction to the monotonous stretches of desert extending north-westward from the Orenburg-Tashkent railway, scant in vegetation and unrelieved by any prominent eminence, the country in the immediate vicinity of Djes Kazgan seems distinctly hilly. However, as a matter of fact, the variation in elevation between valley and crest amount at most to only a few hundred feet. The main valleys into which the extensive southern plains merge are broad and open, and the subsidiary valleys ramifying therefrom are shallow and trough-like. The slopes between are generally gently inclined and well graded. In places, however, the harder rocks appear as pronounced ridges or mesa-like buttes.

In early spring when the melting snows provide abundant moisture the generally drab color of the arid hillsides are brightened for a few weeks by brilliant flora, chiefly red and yellow tulips, with pink and yellow lillies. The streams at that season of the year flow unceasingly, but later even the largest in the vicinity of Djes Kazgan become mere chains of waterholes, and the mines have to depend for their supply of water on that derived from the workings, which is unfit for drinking, or upon wells and catchment basins.

DETAILED GEOLOGY. The copper ore is found in the uppermost group of rocks forming the Permo-Carbon-



THE TRAIN CROSSING THE STEPPES

iferous series. This group, 4000 ft. thick, may be subdivided into four members:

1. At the base, 600 ft. of limestone with interbedded sandstone.
2. Over 1750 ft. of gray sandstone, red sandstone, fine conglomerate, and shale. Of this, the lower 630 ft. and upper 335 ft. consist only of sandstone.
3. About 1050 ft. of shaly beds.
4. 600 to 1000 ft. of cherts, with some shale and limestone.

The copper deposits seem to be associated mainly with the sandstone included in No. 2. This contains grains of quartz, feldspar, muscovite, magnetite, and hematite. The cement is variously argillaceous, chalcedonic, or calcareous. The two types of sandstone, namely, the red and the gray, grade into each other by an increase or decrease in the amount of hematite, which seems to be largely original. The sandstone passes into shale both

upward and downward or along the strike and, consequently, forms elongated lenses.

The immediate vicinity of the copper deposits shows a somewhat indefinite dome-shaped uplift, complicated by a couple of minor folds and by numerous normal faults. The strike of the beds is east and west, but there are naturally variations in every direction. The dip is predominantly southerly, at gentle angles, 15° to 30°.

THE COPPER DEPOSITS of Djes Kazgan are tabular in form, their area being great in comparison with their thickness. Probably the term 'sheet', which conveys the idea of considerable lateral extent in contradistinction to thickness, is the most applicable. In form, they bear a considerable similarity to the lead-zinc deposits of Joplin, Missouri.

All told, a great many distinct sheets have been found within an area of about 20 square miles. These occur in seven or eight distinct localities, each showing a number



A TROIKA ON THE STEPPES

of deposits occupying successive beds of sandstone, separated by beds of shale, in the sandstone-shale member of the Upper Permo-Carboniferous, and invariably associated with faults. Four great ore-horizons have so far been disclosed.

The larger orebodies so far developed at Djes Kazgan contain from 30,000 to 50,000 tons of ore. One particular orebody, known as the Annensky, covers an area of 200 by 500 ft. Another, known as the Petro Hill, is 350 ft. long and 250 ft. wide. The 'A' shaft orebody is 250 ft. long by 450 ft. wide. The thickness of most of the ore varies from a foot and a half to five feet, although local thicknesses of 27 ft. are not uncommon.

The orebodies cease by 'pinching out' either gradually or bluntly against an older fault or joint. The wedging out of the orebodies may be due to a decrease in the amount of fracturing or a change in the granularity of the enclosing sandstone, or to the exhaustion of the ore-bearing solutions.

The known orebodies are situated for the most part either on the crests of hills or on the slopes. In the valleys, which are generally underlain by shale, the ore-bearing sandstones do not generally appear, though naturally they may be expected beneath, and a number of deposits have been located by boring.

The rock most favorable to ore deposition is a highly-jointed medium-grained gray sandstone, containing quartz and feldspar granules in a calcareous matrix. The copper-bearing minerals seem to have replaced first the calcareous matrix, then the feldspar, and lastly the quartz. The orebodies often cross the stratification of the sandstone, the richer ore grading through slightly impregnated material into barren sandstone; usually they lie below an impervious shale, but there are instances where they cease upward in sandstone below shale.

The deposits have a close relationship to faults or sharp anticlinal folds that antedate ore precipitation. Faulting has occurred since, but the later displacement of the orebodies seems to have been unimportant. The outcrops of all the deposits are invariably oxidized, the depth of oxidation depending on such factors as the inclination of the deposits and the position of the water-level, which now stands at from 7 to 30 ft. in the valleys and from 40 to 50 ft. on the hill-crests, but is greatly complicated now, as probably in the past, by the occurrence of numerous highly porous beds interstratified with impervious beds. The copper-bearing minerals of the original ore consist chiefly of chalcopyrite, bornite, and pyrite. The gangue-minerals are calcite, quartz (both crystalline and Jasper), barite, siderite, aragonite, and dolomite. The secondary ores include bornite, chalcocite, native copper, cuprite, malachite, azurite, chrysocolla, cerussite, and native silver, with calcite, aragonite, quartz, chalcedony, siderite, gypsum, limonite, hematite, and manganese dioxide.

The chief mineral of the oxidized ore is malachite. The oxidized ores of most of the outcropping sheets do not extend ordinarily more than 30 or 60 ft. from the surface, but they go much deeper where the orebodies occur near

important faults. In some of them a considerable portion of the copper has been leached, while rich parts of the sulphide orebodies, containing chalcocite and secondary bornite, indicate that there has been in places in the inclined deposits a certain amount of secondary enrichment through the downward migration of copper leached from above. The change effected by secondary enrichment in horizontal sheets has been rather of mineralogic composition (that is, the local alteration of chalcopyrite to bornite or of bornite to chalcocite) than of an addition in metallic content.

The ores of Djes Kazgan, both sulphide and oxidized, are highly silicious. The oxidized ore is essentially a sandstone, more or less completely replaced by malachite. It is ordinarily soft and consequently easily mined. It is generally lower in grade than the sulphide ore, although some of it is higher in grade and contains from 14 to 17% copper.

The sulphide ores, divisible into rich smelting ore and disseminated or milling ore, which occurs on the edges of the ore-sheets, are both hard sandstones unequally replaced by copper minerals. The smelting ore ordinarily runs from 11 to 16%; the milling ore from 4 to 7%. The sulphide ores contain appreciable quantities of silver, generally from 6 to 8 oz. per ton in the richer grades.

The depth to which the ore persists is not yet known. Development by shafts and drifts has so far not extended to any great distance below the surface, not more than 200 or 300 ft., exploration having been chiefly by boreholes which have cut orebodies down to a depth of 700 ft. As the ore-bearing sandstones extend to great depth it is probable that orebodies as yet unknown will be discovered by aid of further exploration.

GENESIS OF THE ORE. The deposits of Djes Kazgan were formed, in the first instance, by ascending solutions, and later were changed in mineral composition by descending solutions, with some attendant shifting of the copper content.

There are many evidences that the original ore was not of sedimentary origin and was formed by ascending rather than descending solutions. Were it sedimentary, the ore would not cross the bedding-planes as is frequently the case; it would not necessarily be confined mainly to the vicinity of faults, and it is improbable that recurring conditions would be favorable for the deposition of ore in a number of horizons.

That the solutions were ascending, seems to be shown by the nature of the original sulphide minerals, containing appreciable quantities of silver and traces of gold associated with quartz and barite; the occurrence of the ore in close proximity to faults, which are always mineralized and commonly below impervious roofs of shale; the connection of the chief centres of ore deposition with anticlinal folds rather than synclinal; and the tendency of the orebodies to be superimposed one upon the other.

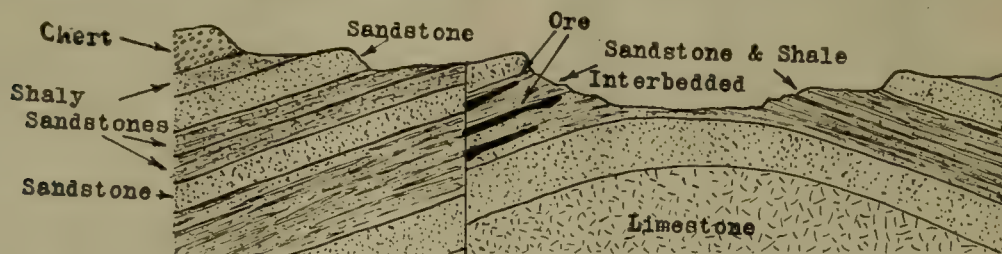
No evidence is available as to the original source of the copper. The metal may have been widely disseminated in the sedimentary rocks and been leached therefrom by

meteoric waters to rise subsequently under artesian conditions. It is possible that the deposits may be of magmatic origin, but if this were the case it is remarkable that no igneous rocks later than the strata in which the orebodies occur are visible near Djes Kazgan. At Yuspensky, 260 miles east, rich copper deposits occurring in lensoid lodes occupy a faulted zone partly in what are thought to be the oldest division of the Permo-Carboniferous, and partly in porphyries and porphyrites. While the majority of the latter antedates the beds with which the deposits are associated, there is a possibility that certain of them may be younger.

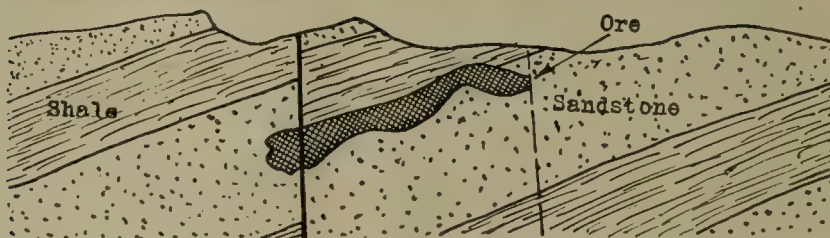
METHODS OF MINING. Shafts, sufficiently large and adequately equipped to handle the ore, have been sunk at most of the principal groups of deposits, and drifts extended therefrom to the limits of the orebodies, cross-

easily accessible manganese ore which received favorable mention from the American geologists who toured the island in the spring of 1917. Early in 1918 a company formed secured control of these deposits and undertook the exploitation of the property. However, the sudden cessation of the War interrupted plans, and little ore has been mined since.

SCHEELITE is much more abundant in New Zealand than wolfram, being widely distributed throughout Otago and Marlborough, where it occurs in quartz lodes traversing mica-schist country. These lodes are always more or less auriferous, and some of them were worked for their gold content years before the fact that they contained scheelite was known. The mineral is also found in gravels derived from the denudation of the lode-



IDEALIZED SECTION OF TYPICAL ATBASAR DEPOSIT



LARGE SCALE DETAIL

drifts, inclined winzes and raises being advanced for purposes of further development. At the end of 1915, 543,900 tons of ore averaging 10.7% of copper, including 154,818 tons of 13.1% ore, was ready for stoping, the greater proportion being sulphide ore.

As already indicated, it is planned to assemble at Karsak Pai the coal from Bai Kanour, the ore from Djes Kazgan, and the fluxes from a variety of localities. Since the site was chosen in 1912, a small town has grown up there with numerous buildings for offices, staff, and workmen, and with a plant for treatment. It was not proposed in the first instance to treat the oxidized ore. The sulphide ore was to be concentrated by water and the concentrate smelted in reverberatory furnaces. The plant, which is practically complete and would long ago have been active but for the War and the ensuing events in Russia, is designed to have an annual capacity of 5000 tons of copper.

NEAR the town of Ponce, situated 25 miles west of Cardenas, Cuba, lie extensive deposits of high-grade and

bearing areas. At the present time the largest amount of scheelite is obtained from the neighborhood of Glenorchy, at the northern end of Lake Wakatipu. Here the ore is found in rich bunches irregularly distributed in rather narrow quartz veins. The quartz throughout contains a little scheelite and a very small quantity of gold. For the reasons that the scheelite is relatively friable, and that slimed scheelite is difficult to save, the ore is reduced to powder in several stages, being treated by jigs between these operations. No attempt is made to save the gold. At Deep Creek, in Marlborough, the scheelite is much more sparingly disseminated throughout the ore, which, moreover, contains a notable amount of gold. The only lode worked is large and irregular. Here the ore is pulverized in one operation in a stamp-battery, the gold being saved on copper-amalgamating plates and the scheelite on Wilfley tables.

THE diamond production of the Union of South Africa for 1919 was 2,588,017 carats valued at more than fifty-seven million dollars.

Mr. Govett on the Gold Problem

[Herewith we publish part of the speech delivered in London by Francis A. Govett, chairman of the Ivanhoe Gold Corporation, a famous West Australian mining enterprise, on the occasion of the annual meeting of that company.]

The problem of the premium on gold and the exchanges generally is not at all well understood; it is questionable if anyone really is master of the subject, and it seems to me we are all groping in a sort of fog, when you see what is done by expert financiers, as, for instance, by the Indian government in their futile attempt to stabilize the Indian exchange. With the other gropers I am going to turn my humble lantern on the fog and offer you a few suggestions. First, let me call your attention to the fact that, in this free-trade country, the gold-producers have not been free to trade. All through the War until quite recently, we have been compelled to sell our output to the Government at the mint-value of our gold, while the silver-producers have rioted in possession of the open market, subject only to the excess-profit duty for such as could not entirely escape. This is the grossest favoritism and neither just nor honest. The Government just stole the whole of our profit and let the silver-producers go free and profit by the preposterous rise in price, which there is good reason to believe would never have taken place but for the arbitrary interference of the Indian government in its embargo on silver exports from India. However, I only mention that in passing. The gold premium in any country is, of course, roughly the equivalent of the highest measure of adverse exchange against that country. Gold represents the parity of exchange, and the more adverse it is the higher the premium which must be paid for gold. It seems to me that gold is fearfully regarded as a sort of fetish, while it ought to be just a useful servant. In normal times it is a most useful, efficient servant. In times like these I submit that it would be vastly more useful than it is if it were not held back, but freely used for what is, after all, its primary function—the protection of the foreign exchanges.

Leaving out the complication that gold itself is a commodity, it has two main functions, which in normal times apparently do not conflict, but which in times like these are irreconcilable. Gold men seem to have no doubt that the chief function of gold must be to back the internal paper currency in any country; that is to say, that you must keep sufficient gold in your vaults to meet any possible panic run, to exchange that paper into gold. I have never heard of but one suggestion of a cent. per cent. reserve in gold; that was for a special reason, and universally the gold in reserve is insufficient to redeem more than a very moderate percentage of the paper issued and in circulation. A moment's reflection will show you that in practice this means that the notes issued

are only really backed by gold so long as gold is not seriously demanded; for in times of panic or serious danger either the Bank Act is suspended or the convertibility at once suspended. That is to say, the gold backing for the paper currency is entirely Christian Science: you can get gold for your paper only so long as you do not want it. Let us draw a logical deduction from that. For six years past, except nominally, the convertibility has been suspended, and, except in very small amounts, you could not get gold for notes; but the credit of the note—the currency, either Bradbury or Bank of England—has not been damaged to the extent of a penny piece. The fact that prices have risen does not mean depreciation of the currency; nor is currency inflated; currency is not inflated until the currency in circulation is in excess of the demand. At the present time more people with higher wages have been competing for scarcer commodities, more currency has been required, and paper internally has not depreciated in gold. Try it for yourselves. You can get probably fifty or a hundred sovereigns from the Bank, once at any rate, without being followed by a detective; go and see if you can buy more commodities with your hundred golden sovereigns than you can with a hundred Bradburys. You cannot do it, unless you sell your gold to an illicit buyer who proposes to melt it down. I regard that as Q.E.D. The deduction is that the notes issued must, and do always, in fact, rest on national credit, and not on gold, and this function of gold in practice is just a fetish.

The second function of gold is vastly more important. As an almost universal measuring rod of the value of commodities gold is useful; in fact, indispensable, and all nations ought to have their currencies based on gold. There is nothing else to take its place. The exchange position between two countries is just the measure, in gold, of the balance of indebtedness on either side for commodities bought and sold; that is the balance of trade. Ultimately, of course, the imports of our country must be paid for by exports if equilibrium is to be maintained. Temporarily this balance can be adjusted and the exchange protected by export of gold, but ultimately it must be settled in commodities or other services known as invisible exports. When exports are continuously insufficient to balance imports a nation is getting into debt. This fact is shown by a fall in the exchange, for differences are paid by bills of exchange, and as they get scarce a larger amount of currency in one country must be paid to obtain bills of exchange in the other. The exchange falls—that is, the price of bills rises—until the gold point is reached, when it becomes cheaper to export gold than to buy bills. At this juncture the directors of the Bank, who hate parting with their imaginary gold backing for their note-issues, start in to interfere with this function of gold, which is to

protect the exchanges. They proceed to raise the bank-rate, regardless of the losses involved thereby to the whole of the trading community in having to pay a higher rate for loans where there is no increased demand for loans, their object being to attract foreign money here to benefit by the higher rate, and so obviate the need of exporting gold. To me this seems a singularly cumbersome and costly method, callously shoving the cost and consequent loss onto the backs of entirely innocent parties. It also tends to obscure the real position of the amount of the international indebtedness; in a way it is faking the hand of the pressure-gauge, the exchange. This, however, in normal times perhaps is not of much importance, though what it costs in dearer money, which is of vast importance to the traders, is just hidden.

So much for normal conditions; now declare war. First step, embargo on the export of gold. Here, then, you arrive at the ridiculous position that in time of serious need within the country the gold in the vaults is no longer available to back the internal note currency, lest it be wanted to protect our foreign exchange, and when it is needed to protect the foreign exchange it is not allowed to be used for that purpose by an embargo on export for fear of there being no longer a gold backing for the notes, which is absurd. With the outbreak of war our imports from America, of course, at once enormously increased, and, in order not to part with gold, the exchange was 'pegged' in other ways, namely, by borrowing in America, which was costly, and by shipping to America every block of interest-bearing American securities on which the Government could lay its hands, which was also very costly, instead of shipping non-interest-bearing gold. Now, you will note that gold itself has no commercial value outside its value as an ornamental commodity, which is comparatively inconsiderable, outside India and China, which have always regarded metals as the basis of wealth, or wealth itself. Beyond the needs of gold countries for actual coinage and later as a conventional backing for note-issues, no country seems willing to absorb more than a given amount of gold, as it is a costly business, for it bears no interest; it is just dumped into a vault to be held there as the limitation of, and the backing of, the paper currency, for which purpose, as I have said, it is never used when need is really great. There must then come a point when, so far from wanting to absorb more gold, a country will and must rebel against taking more, and at that point, if this function of gold be freely exercised, the exchange will steady. This point did arise with Norway. I always said that the proper course was not to hoard our gold as an imaginary backing for our note-issues, but to force it upon reluctant America, and it is rather curious that on the first threat in March to pay off a hundred millions in gold the American exchange rebounded some 70 cents. Was it *propter hoc* or *post hoc*? I do not know, but it is suggestive. Whether that be the case, this at least is plain: when exchange falls to the gold point, and we won't ship gold, exchange must further fall, as it did fall when the artificial pegs were taken out.

The result is that first, we are still paying about 30% higher for everything which we buy from America: we were already heavily in debt, which we could not pay, so that this implies increasing that debt much faster than is necessary, while an exceedingly bad point is that it obscures the real position. There are few people, even business men, who think much about exchange. They just accept the fluctuations as something which cannot be remedied, and are satisfied to leave the matter in what they regard as expert hands. The general public knows nothing about exchange. The result is that the writing on the wall, the indications of the gauge, are absolutely disregarded; if you face the facts, the country is bankrupt, if bankrupt means that you cannot pay, that you can only buy on credit on ruinous terms, and the debt is rolling up. Even now we are not exporting enough to balance our imports, even including the increased exports, and the colossal freights which still are charged by British shipping, yet the heedless public continues to spend its money in an orgy of extravagance, increasing the adverse balance of trade by buying American motor-cars and tires, and a host of unnecessary things which are quite as well supplied from here.

So much for gold; but to point the moral of this sermon it is necessary to add a few short notes on silver. Passing by the extraordinary favoritism which has been shown to silver-producers, the troubles of exchange are plainly bad enough between countries with gold currency, but it is made far worse by the fact that two big countries, India and China, in practice are on a silver basis, with smaller suffering communities like Ceylon or East Africa. To be as short as possible, about twenty years ago, when silver was low and the rupee had fallen to about 14 pence, the Indian government embraced the bi-metallic heresy, with fine contempt for the economic law that "it is not possible to fix a ratio between two fluctuating values". They fixed, as they thought, to all eternity, the rupee at 1s.4d., or 15 to the pound. Curiously enough, though thoroughly unsound, it was good business. For many years it looked as if they were right and as if they had fixed the rupee for a reason not immediately apparent. In fact, the value of the silver in the rupee never rose above that figure until the War, and consequently the rupee was practically a token coin. When at last silver rose, the dog began to bite the pig and the law began to work. Of course, the ratio was blown to smithereens, and the rupee rose to 2s.4d., above which figure all costs in India paid from here had risen 75%, which was disastrous. Then the Indian Council, with a committee of experts, and the Secretary of State arose and proceeded to reaffirm the bi-metallic heresy, this time proclaiming they will have stabilized the exchange, by fixing the rupee at 2s. instead of 1s.4d. when once gold gets back to parity. They thought that it would be better stabilized by tying the rupee to gold and fixing the silver in the rupee at 2s. or 10% of the gold in the sovereign, instead of tying it to the pound, and that the rupee would rise and fall with gold instead of with the currency which they call sterling. But as the rise in gold is the exact measure of the so-called fall in cur-

rency, the change, of course, is no change at all. It seems to me the rise in the rupee must be just the same, whether in the direct ratio with the rise in gold, or, conversely, with the fall in currency or sterling. Their idea seems to be that when gold gets back to parity, even though the value of the silver in the rupee falls below 2s., the rupee would become a token coin.

Some of the immediate results of the enactment are that the exchange was not stabilized at all; the rupee immediately rose from whips at 2s.4d. to scorpions at 2s. 10d., at which price I honored a bill which I propose to frame as a monument to their sagacity, since when it has fallen back to 2s.4d. the fluctuations not following at all the price of gold as they said it would, nor indeed the fluctuations in silver. But will the rupee be fixed at 2s. when at last it gets there? Will it consent to be a token coin? This is the point. I spare you that, but the fact remains that we have not been yet relieved in any way by this magnificent enactment, for we were exposed to the additional loss involved by the further rise from 2s.4d. to 2s.10d., while if silver should fall again to a normal price, we shall be deprived of any benefit under 2s.; in other words, their deliberate intention was that we were to have our working cost increased by 50% in perpetuity. And they plumed themselves "on the skill, courage, and resource which the government of India and the India Office have shown in dealing with the complicated and ever-changing problems that had presented themselves in connection with the India currency system", which is rather queer reading when the minority report attributes the whole of the trouble to the constant interference of the Indian government with the exchange and with free dealing in gold and silver. As I have said, there is indeed strong reason to believe that had it not been for the embargo on export of silver from India the great rise in silver would never have taken place.

Now for my conclusions. Gold has rendered good services; it has provided a most convenient common measure for the internal exchange of all commodities, and for international exchange, there being a fixed amount of fine gold in the unit coin of any country. This being so convenient, it is absurd that complications involved by the use of silver as a collateral basis of exchange should be tolerated, or that any country should remain on a silver basis; still more absurd that any of these countries should be a country within the British Empire, like India, Ceylon, and East Africa. We cannot compel China to come in, but there should be a uniform currency for the Empire with its base the British sovereign. It does not matter what may be the denominations of the subsidiary token coins so long as they are really tokens and not like the rupee, a coin of value above 2s. and possibly a token when silver falls below. Internally the use of gold itself as pocket coinage is most extravagant; for six years past we have done well without it, and I have shown that in practice it is never used in times of need for one of the purposes for which it nominally is available—the backing of the note issues

in circulation. To me it seems, then, better to recognize the actual facts that the note issues are not backed by gold at all but rest on national credit; to confine the use of gold to the sole function of the adjustment of international indebtedness and actually to use it when it is wanted; that is to say, instead of hoarding the useless gold in the bank vaults it should be used in paying our external debts at \$4.86 instead of our buying bills, as we have done, as low as \$3.20 at a heavy loss, which means that we were paying 40 to 50% more for what we buy and increasing our indebtedness by that amount. Take the whole of the gold and hurl it at them: one of two things will happen—either the exchange will immediately rise in their unwillingness to take gold, or they will take it and we shall have saved some further debts, and then we shall be no worse off than at the present moment and at least we then shall know where we stand, for we shall be back on the real basis of our national credit when, perhaps, at last we may begin to grasp the facts and to economize a little, while the internal credit of the Bradbury will still be unimpaired.

A SHAFT 12 miles deep is proposed by Sir Charles Parsons, lecturing recently at the Royal Institution. He says that the cost of boring the hole would not be so very great. In countries where the atmosphere is dry the sides of mine shafts are cooled by sprinkling them with water, the evaporation of which cools the rock. This effect might be augmented by artificially drying and cooling the air before passing it down the mine. With still greater depths of shaft further methods of cooling would probably be necessary. The heat might be carried upward by means of brine circulated in a closed ring of steel pipes with a rising and descending column, or a simpler method would be to arrange for a rain of liquid air down the shaft. When sinking the deeper portions of the shaft probably shields would be required to protect the miners from the splintering of the rock, since the intense compressive stress splits off scales from the surface, sometimes with considerable violence. When he first brought forward his suggestion, in 1904, the estimate of the time required to sink a shaft twelve miles deep was eighty years; but with improved machinery and methods the records have been so much lowered that he now thinks an estimate of thirty years reasonable.

THE aluminum produced in the United States during 1919, was valued at \$38,558,000, as compared with \$41,159,000 in 1918. This decrease of \$2,601,000 was probably due to a curtailment of production in 1919, forced by the accumulation of large stocks of aluminum by both the Government and the manufacturers in 1918. The market prices quoted during the first four months of the year were lower than those which prevailed during the remaining months, and apparently most if not all of the stocks were taken by the beginning of the last quarter.

TWO THOUSAND men are engaged in the oil industry of Pechelbronn, Alsace, where 50,000 tons of petroleum products are produced annually.

Froth-Flotation at Broken Hill

By C. C. FREEMAN

***INTRODUCTION.** Although great progress has been made in flotation of the Broken Hill silver-lead-zinc ores, no paper dealing with this subject has been presented to the members of the Institute since James Hebbard's valuable contribution in 1913.

Almost every discovery or development in the history of flotation has formed the basis of a patent, and but few experimentalists have overlooked the fact that their investigations might lead to the establishment of a patentable process. This, together with the aftermath of patent litigation, naturally resulted in secrecy being maintained in matters appertaining to the art, and the industry as a whole has consequently suffered considerably. Much valuable time has been wasted through numbers of men repeating work along certain lines, which, unknown to them, had already been thoroughly exhausted by others, whereas a lot of this would have been avoided by a freer interchange of information among those directly concerned.

Owing to differences in the ore treated and the various applications of flotation concentration in relation to gravity methods, the flotation problems of the various mines differ considerably. This, together with the secrecy previously referred to, has resulted in the development of numerous systems and machines, most of which would appear, to the casual observer, to comprise separate and distinct processes. I have endeavored to show how much these processes have in common with one another, and, at the same time, have tried to convey some general ideas on flotation to those members of the Institute who are not directly associated with this branch of concentration.

Many theories have been expounded dealing with the underlying principles that control flotation, and while some of these appear to explain satisfactorily certain of the phenomena, a number of them are of little practical use, and are really only of academic interest. Generally speaking, the men who are directly connected with flotation operations are busily engaged attending to the practical and economic considerations, and have but little time to devote to the purely theoretical aspect, which perforce has to be left to the scientist.

Today all operators have certain general ideas on flotation, but few would dare to predict the result of treatment of an ore by any flotation method without first having recourse to a laboratory or other testing-machine. Undoubtedly, the experimental machine is still the mainstay of the flotation man for all research, investigation, and plant-control work.

Although several of the earlier flotation methods employed other principles, almost all the processes in use in

Broken Hill today rely on the carrying power of air or gas bubbles to which the floated material becomes attached, and this paper will only deal with this type of flotation, which is commonly called froth-flotation.

Developments in flotation have shown that most of the minerals possess surface properties which allow them to become attached to the air or gas bubbles more or less readily. These properties are not, as was originally believed, confined to those minerals having the metallic-like surface of the sulphide minerals, but are also possessed, in some degree, by most other minerals and many artificially prepared salts.

The art of flotation depends on making use of the varying degrees of these properties possessed by different minerals, and, in cases where a separation is required of two minerals possessing the properties to approximately the same extent, by physically or chemically altering these surface properties of one of the minerals, so that one mineral will float more readily than the other.

It may be as well to point out, at this stage, that the terms 'preferential', 'selective', and 'differential' have been used to describe flotation methods whereby one sulphide mineral is separated from another. In Broken Hill these terms are practically synonymous, but, for convenience, I have used 'preferential' when referring to methods based on chemical alteration of the surfaces of one or more of the sulphide minerals, and 'differential' for all other methods where no definite chemical alteration can be detected. It will be noted that the only difference is that in the former case a preliminary treatment alters the physical conditions of the surface of some of the minerals by bringing about a surficial chemical alteration of the mineral itself, and that the actual flotation separation then becomes identical with the 'differential' systems. As will be shown, the general principles involved in the differential methods are the same as those in the older methods that separated the sulphide minerals from gangue minerals, producing what is known as a 'collective' or 'mixed' float. Certain conditions are necessary to bring about the attachment of sufficient air to an ore-particle to cause the latter to rise to the surface of the liquor. In the case of those minerals—such as some of the sulphides—which most readily become attached to the bubbles, flotation will result when the conditions are developed to only a slight extent, but these conditions must be intensified considerably to bring about the attachment of the air and a less readily floated mineral particle. By controlling the degree of intensification of conditions that bring about this attachment it is possible to separate a mineral which becomes readily attached to the bubbles from another mineral, the surfaces of which have a lower affinity for the same bubbles.

*A paper read before the Broken Hill branch of the Australasian Institute of Mining and Metallurgy.

Thus, if a mixture of evenly-sized particles of three minerals—(a), (b), and (c)—be subjected to flotation, and if, under the general conditions used, (a) possesses surface properties such that the air-bubbles become more readily attached to it than to (b), and (b) possesses such properties more than (c), it will be possible to arrive at a set of flotation conditions whereby (a) can be floated away from (b) and (c). By intensifying these conditions a point will be arrived at when (b) can be floated away from (c). If these latter conditions are used on the original mixture the float would contain both (a) and (b). Thus, the general principles governing the differential flotation and the older collective methods are identical; but, while in the latter case the margin in surface properties in regard to bubble attachment between the least floatable sulphide minerals and the dull, oxidized, or gangue minerals is very marked, this difference is often small in the former case. In collective flotation, therefore, one may vary the flotation-intensifying conditions considerably without materially affecting the result, whereas preferential flotation is a much more delicate operation, requiring careful control in most cases. In view of the fact that the early work in flotation at Broken Hill was directed toward the recovery of blende from mill-tailing, de-leaded by gravity-concentration methods, and also that the blende required more intense flotation conditions than the other associated sulphide minerals, it was only natural that the conditions developed at that time were sufficiently intense to promote collective flotation.

Flotation ideas thus developed along lines that embraced the liberal use of several of the intensifiers, such as power, heat, acid, and frothing-agents. From this it became accepted, at that time, that flotation concentration could only be employed to separate minerals with a metallic-like surface (such as the sulphides) from materials with dull and easily-wetted surfaces. No doubt the fact that so much work was done on more or less weathered dump-tailing, in which the relatively low galena content had become sufficiently superficially oxidized to reduce its flotation properties to at least as low as that of the blende, was responsible for the number of years which elapsed between the establishment of the collective and the preferential flotation methods.

DIFFERENTIAL FLOTATION. As previously stated, the principles involved are identical with those used in the earlier collective-flotation methods, and differential results depend on the control and modification of those principles. The method depends primarily on the fact that, owing to the physical properties of the surfaces of minerals, the bubbles become more readily attached to the surface of some minerals than others, and, by regulating the intensity of the conditions bringing about this attachment, it is possible to form bubbles carrying only the former minerals. The galena in freshly mined Broken Hill ore possesses the flotative property to a greater extent than the blende, and all the differential-flotation methods now used on this field recover the galena in the first float.

Much has been written in technical journals dealing with what may be termed the elements which produce the conditions necessary for the attachment of the mineral particles and the bubbles. A brief review of these may be of interest. The intensity of the flotation conditions produced is the sum of the effect of each of these elements, and those most commonly used are:

1. Air (or gas as CO_2 generated from carbonates in the pulp). This is essential in froth-flotation as a buoyant to carry the mineral. Within limits, the intensity will vary with the quantity of air introduced into the pulp.

2. Agitation. A certain amount of agitation appears to be essential to all flotation. It has been stated that the main function of agitation is to bring about an intimate admixture and distribution of the oil, and, while this is no doubt true to a certain extent, the fact that agitation is necessary when soluble frothing-agents are used would indicate that the function of agitation is not limited to the above. Agitation also plays an important part in cleansing the surfaces of the mineral particles, breaking up the air into minute bubbles, and promoting a coalescence between the oiled particles. The agitation need not necessarily be applied in the flotation machine, and, in some cases, the flow of the pulp through grinding machines, launders, and elevators, after the addition of some or all of the flotation reagents, will provide sufficient agitation for the removal of a readily-floated mineral. Owing to the large expenditure of power for agitation, this subject has received a lot of attention, which has resulted in the development of a great variety of flotation machines. The author's experience, however, has been that, with a given set of conditions, a definite expenditure of horse-power is required to produce a given result, and that frequently a saving in power can be economically effected by increasing some of the other intensifiers or elements.

3. Frothing-agents, which consist of soluble salts, or, more frequently, oils. The American writers have classified oils as 'frothers' and 'collectors'—the former containing more or less constituents which are soluble in the flotation circuit, and the latter insoluble oils which coat the sulphide-mineral particles. A number of oils, particularly many of the Australian eucalyptus-oils, possess the properties of both frothers and collectors. In flotation practice in America great stress seems to be laid on the oil or mixture of oils used; but, while many different oils have been tried in Broken Hill, the eucalyptus and a few coal-tar products are the oils most generally used. American pine-oil or pine-tar oil is used to a limited extent in a few cases. The eucalyptus-oils used consist mainly of dextrapinene and phellandrene. Some of the oils characterized by being relatively low in phellandrene will, in many cases, give good results, but may require the addition of a certain amount of a 'collecting' oil to make the float sufficiently stable. Usually a number of oils or oil-mixtures can be found that will produce identical results, and the final choice in the oil is decided by the cost factor.

4. Acid is a potent intensifier. It is universally used in Broken Hill in connection with blende flotation, excepting in cases where the ore is so calcitic that the consumption of acid becomes prohibitive.

5. Temperature invariably increases the intensity of the flotation conditions. Owing to the high price of fuel in Broken Hill, heating-plant circuits are somewhat expensive, and every endeavor is made to carry out operations at atmospheric temperature. Generally speaking, the end-point of a flotation separation is sharper and more clearly defined in hot than in cold circuits.

Within limits, similar results can usually be obtained by increasing one element and correspondingly decreasing another, so as to retain the same intensification of conditions. Thus, two plants working on similar material may obtain similar results, although in one case very little reagent and a lot of power are used, whereas in the other less power but more intensifying reagents are employed.

Given two minerals with an appreciable difference in their flotative properties, a separation can be effected in a fresh-water circuit by applying some or all of the above elements, and, although this can be applied to the separation of galena from blende in many of the freshly-mined Broken Hill ores, the difference in the flotative properties of these minerals is often so small that such a process is rather too delicate and sensitive for ordinary purposes. Lyster discovered that the presence of salts, such as the sulphates of many of the metals in the circuit-water, retarded the flotation of the blende, and this principle has, either directly or indirectly, been applied in all the Broken Hill mills that are practising differential flotation. When using this system for differential galena-flotation, the blende is subsequently floated from the gangue by increasing the intensity of the flotation conditions by application of acid, heat, oil, or other intensifier. Some of the mines supply the necessary salts to their mill-circuits by using the underground mine-water, whereas those plants using H_2SO_4 in connection with their flotation operations create an ample supply of salts for differential-flotation purposes. The return circuit-water, besides containing these salts, also retains a certain amount of the soluble frothing constituents of the oils used. These conditions are favorable for differential galena-flotation, and advantage was taken of this by the Junction North Company (in their cascading plant), the Central Mine, and the Zinc Corporation (in their zinc concentrator). Very small additions of oil frequently improve galena flotation without raising the blende under these conditions. Prior to the development of differential flotation it was recognized that if the percentage of these salts in the circuit-liquor became too high, blende flotation was difficult, even in hot, faintly-acid solutions. Thus, T. J. Hoover, in 'Concentrating Ores by Flotation', referred to the fact that at the Zinc Corporation plant the blende flotation invariably went off when the quantity of salts in the solution exceeded 3000 grains per gallon.

Reference may be made to the fact that the ore from the Broken Hill lode may be divided into two distinct

classes, consisting of sulphide minerals (chiefly galena and blende) in a rhodonitic gangue on the one hand, and sulphide minerals associated with a gangue containing up to 10 or 12% of calcite on the other hand. The difference in the flotative properties of the galena and blende is slightly less pronounced in the rhodonitic than in the calcitic class of ore, so that differential flotation is somewhat more easily conducted when dealing with the latter ore; but in this case several of the methods which depend on the use of acids cannot be so economically applied, on account of the high acid-consumption involved.

The circuits necessary for the above type of differential flotation are so cheaply obtained that this method is used whenever possible. In some cases, however, the flotation properties of the galena and blende are so nearly alike that the presence of the salts in the circuit solutions will not sufficiently retard the blende to allow of satisfactory differential results. This occurs with some of the rhodonitic classes of ore, even when freshly mined, and in most of the tailing and slime that has been exposed to weathering. The Bradford SO_2 method is largely used for differential treatment in such cases. The presence of SO_2 in the solutions retards blende flotation to a greater extent than the salts referred to above, and this allows the use of conditions sufficiently intense to float even slightly tarnished galena particles without raising the blende. Subsequent flotation of the blende may be effected by removal of the liquor containing the SO_2 , by removal of the SO_2 by aeration or heat, by decomposition of the SO_2 by chemical means, or by further intensification of the flotation conditions by acid and heat. A diversity of opinion exists as to whether it is essential to have salts in solution to obtain the best results with this process. As acid is used in all Broken Hill plants using the SO_2 process, this is of little account under normal plant-conditions, but is mentioned for the benefit of those engaged in laboratory work.

A new method was recently patented by T. H. Palmer, H. V. Seale, and R. D. Nevett, by which results similar to those yielded by the Bradford SO_2 process are obtained. The patentees claim to make a solution of S by boiling tar or other oils in a weak solution of H_2SO_4 in the presence of an excess of powdered sulphur. Whether the sulphur goes into solution as an organic compound, or whether the sulphur removes the fractions of the oil that promote blende flotation, leaving a solution of only the fraction or fractions suitable for galena flotation, is not yet known. Whatever the action may be, the results obtained by the use of this process at the Junction North mine, where the process has displaced the SO_2 process, clearly demonstrate that the process yields the results claimed, and, in view of the fact that subsequent blende flotation can be obtained by heating the pulp only to about $120^\circ F.$, the process, where applicable, appears to be less costly to operate than the SO_2 process. When operating this process it is necessary to have soluble salts, such as the sulphates of some of the metals, in the circuit-water.

The methods outlined above cover most of the differen-

tial flotation at present in use in Broken Hill. Many other processes have from time to time been patented, but very few have actually been tried on a working scale. The permanganate method of T. M. Owen and H. V. Seale is claimed to give exceptionally good differential-galena results on weathered slime, but, owing to the prohibitive price of this salt during recent years, the process has not been applied commercially. This process appears to embrace some of the anomalies so frequently encountered in flotation, in that, whereas the Bradford process applies SO_2 or other reducing agents, and Lyster uses a circuit containing soluble sulphates, etc., and bichromate has been claimed as producing differential-blende flotation, the permanganate (which is an oxidizer) yields a galena float, and the success of the process depends upon using a circuit containing a relatively small quantity of salts in solution. A soda-ash circuit will give sharp and clean differential-galena results on freshly-mined ore, when only little or no oil is used, and has the advantage that the subsequent flotation of even the coarser blende can be very readily obtained by the use of oil and a salt, such as CuSO_4 . This process has been successfully applied elsewhere, and would be particularly useful in districts where sulphuric acid is difficult to procure.

The size of the mineral particles has an important bearing on results, and the larger the particles to be floated the more intense must the conditions be. It therefore follows that, given conditions wherein galena particles have greater flotative properties than blende particles of a similar size—or, in other words, when the intensity of the flotation conditions necessary to produce flotation of the galena are less than those necessary for the flotation of the blende—to float any larger particles of galena that may be present it may be necessary to increase the intensity of the conditions to the extent necessary to cause the finer blende particles to float. When dealing with relatively coarse particles of galena and blende, differential flotation becomes difficult, this being probably due to the high specific gravity of the galena compared with that of the blende, which causes the ratio of surface to weight to decrease more rapidly with the former than with the latter mineral as the size of the particles increases. A process such as the Bradford would, to a limited extent, allow a somewhat larger latitude in the relative sizes of the galena and blende particles submitted for differential flotation. Fortunately, very little coarse galena gets past the gravity-concentrating machines and reaches the flotation units; in fact, in all products from tables, classifiers, etc., there is a natural tendency for the galena particles to be smaller than the blende particles, and this materially assists differential-galena flotation.

PREFERENTIAL FLOTATION. It was early recognized that it was possible to alter the surface of some sulphide minerals so as to reduce their flotative properties and still leave the surface properties of other associated minerals unaltered. Most of the research work, aiming at the separation of galena and blende, was directed along these lines prior to the establishment of the Lyster process. A low-temperature roast was used in the Horwood process,

and a lot of investigation was carried out to endeavor to obtain similar results by chemical means. The blende being a relatively stable mineral compared with the other sulphide minerals, it naturally followed that efforts were directed toward the alteration of the surface of the galena. Under this heading may be included the processes using oxidizers, such as ferric chloride, in hot acid solutions, and the Bradford acid-salt method, the latter attacking and altering the surfaces of the galena, some of the lead from which passes into solution as a chloride. All these processes are characterized by the blende being floated before the galena, and nearly always result in a zinc concentrate containing relatively high silver-values. This is no doubt due partly to the fact that the silver minerals, being readily floated, tend to rise with the first float, and is also partly due to the silver from any soluble silver salts formed by oxidation, etc., being precipitated on the blende. In view of the fact that only small payments are made for silver in the zinc concentrate compared with almost full value for any silver in the lead concentrate, it is of prime importance to recover as much of the silver as possible in the latter product. This phase of the question affected the economic position to such an extent that investigations on these lines were almost abandoned soon after the establishment of the earlier differential-galena flotation methods. One may safely state that these preferential methods would be applied to lead-zinc-silver ores only in special circumstances, and then only when differential methods of flotation had failed. With the exception of the Horwood process, none of these methods is now employed at Broken Hill.

MACHINES USED. The British Broken Hill Proprietary and the Zinc Corporation still retain the original M. S. type of machine, with separate mixing and spitz compartments, together with the underflow pipes. These machines give excellent service when a strong persistent float is produced, and have the advantage of the level of the pulp in each flotation compartment being under control. This control is of great importance when applying an acid treatment to ores containing varying quantities of calcitic materials, such as may be encountered when dealing with a mixture of material from several mines or tailing-dumps. In this case an increase or decrease in the quantity of CO_2 evolved reduces or increases the specific gravity of the pulp-gas-air mixture, and, unless the pulp-level in each cell can be independently maintained, it is difficult to control the froth-overflow. Apart from the gas factor, the single-level or staggered modification of this machine will, on fine material, give equally as good results as will the original type of machine with the underflow pipes. Boxes of the above types, even when reasonably crowded, do not allow of a rapid removal of the froth when formed, and are not favored in cases where a tender froth is produced. The term 'crowded' refers to a reduction of the area of the box toward the point at which the froth overflows, so as to increase the amount of froth reaching a given surface-area. This results in a quicker removal of the froth, and reduces the relatively dead surface-area away from the overflow-lip. The crowding should not be at too flat an angle, and

the lip should be on a vertical side of a box rather than over a 'crowded' side. The reason for this is that a larger amount of froth reaches the surface close to the crowded side, and this keeps the froth over the whole of the surface moving toward the lip, besides which the pulp at the surface close to a crowded side of a box is more agitated by ebullition than that at a vertical side, so that, if the lip is placed in the latter position, the chances of gangue being carried over mechanically are reduced.

The Central mill has adopted a single-level type of machine, in which the float is taken off the top of the mixing-compartment. In this case the necessary air is drawn in below the impeller, and the 'still zone', necessary to allow the mineral-charged bubbles to rise to the surface, is produced by baffles arranged above the agitation zone. A modification of this type of box is to be seen at the British mine, North mine, and the Zinc Corporation differential slime-plants. In these instances the air is drawn through hollow over-driven vertical spindles operating more or less shrouded impellers near wearing-plates at the bottom of the boxes. The 'horizontal' type of box has gained considerable favor of late, especially for slime flotation, and is now used for slime treatment at the Junction North mine and Amalgamated Zinc works, and for all flotation purposes at the Block 10 mine. Several of the other mines are contemplating the installation of this type of machine in place of the existing ones. This machine gives good results, but the horse-power consumed per ton treated is on the high side. Centrifugal pumps delivering into crowded spitzkasten boxes are still favored at the Broken Hill Proprietary mill, but, although this type of machine was for a time used to a certain extent in some of the other mills, they have since been replaced by machines of other types. One company uses a modification of the Owen machine for differential slime-flotation, but, owing to the exceptionally high power-consumption per ton treated it is questionable if this is the most economical type of machine.

CASCADE BOXES OR POTS. This system, originally introduced by H. V. Seale and W. Shellshear at the Junction North plant, has been applied, for differential flotation, in a portion of the Central mill, and for blende flotation at the Amalgamated Zinc plant. Although, at first glance, this machine would appear to reduce considerably the power necessary for flotation, this is only true to a limited extent. When an ore, prior to reaching the flotation machines, has received almost sufficient agitation to produce flotation, the cascade machine will yield a satisfactory float, but in other cases additional agitation must be provided before passing on to the cascade unit. As in the case of the pneumatic machines, the cascade pots will only give an incomplete recovery, unless the minerals are sufficiently prepared beforehand. Pneumatic machines have been tried experimentally by a few of the mining companies, but they failed to give satisfactory results.

SCOPE OF DIFFERENTIAL FLOTATION. With the successful establishment of differential flotation, the opinion was expressed by some that Broken Hill milling practice would sooner or later be revolutionized by a general replacement of gravity-concentrating machines (such as

jigs, tables, and vanners) by flotation methods. Flotation quickly displaced the vanners and tables operating on slime and fine mill-products, the recovery of the slimed galena from which had previously been a bugbear. It must be remembered that the galena that could not be recovered by tabling was in a fine state of division, and was, therefore, in an ideal state for differential flotation. Owing to the ease with which the coarser galena particles can be recovered by gravity concentration, and to the difficulty of differentially floating such particles, the local mills still retain their jigs and Wilfley tables for primary treatment. In the Central mill cascading has replaced all of the primary tables, and the tailing from the former is lower than that previously yielded by the Card table. Rasmus J. Harvey has shown that the galena in the feed treated is all comparatively fine, and that that recovered from the cascade plant is much finer than that previously recovered by the tables. This means that the galena in the tailing from this section is coarser when cascading is used than when the tables were used; but this galena, passing on to the zinc section, would be recovered more readily in their 'de-leading' tables than galena in a finer state of division.

No doubt a certain amount of the work at present done by tables for the recovery of fine galena will ultimately be performed by flotation, and, in view of the fact that in a hydraulically classified product the galena particles are smaller than the blende particles, close classification should assist in bringing this about. On the other hand, jigs and tables are not expensive machines to run; they make good recoveries of the coarser galena in a concentrate that contains less blende than an equivalent flotation product, and the concentrates produced by the former methods are more easily drained and handled than those produced by the latter. In the light of present knowledge I am strongly of the opinion that the major portion of the gravity concentration now practised at Broken Hill will not be replaced by flotation.

The successful application of collective flotation for separation of the sulphide lead-zinc-silver minerals from gangue has been responsible for a revival of investigations of leaching methods for the recovery of lead and silver. Much research work with various solvents was carried out at the Broken Hill Proprietary prior to 1900, but, owing to high operating costs, such processes could not be economically applied to the relatively low-grade mill-products. Now that it is possible to obtain high-grade mixed sulphide products containing very little gangue, the possibilities of these methods have been greatly increased. The solution of the galena never did present any serious difficulties, and it is now claimed that high extractions of silver can be obtained in the presence of unaltered blende. These methods, yielding a much more complete separation of the lead and silver from the blende than that obtained by any of the known differential or preferential flotation systems, will, with further development, be able probably to compete with flotation methods in many instances. The high operating costs of the solvent methods will, however, to a certain extent offset the increased lead and silver recoveries, and the

scope for such systems can only be determined by economic results. Undoubtedly there is room for both systems in Broken Hill, and the solvent methods should be of special advantage for treating slime-mixed concentrate or slime-middling, which products are usually rich in silver.

Reference must be made to copper sulphate, the use of which has considerably increased during recent years. Although originally specified in a patent of Bradford's, it was not, so far as I am aware, used commercially in Broken Hill until 1916. Small quantities of copper or any of the highly electro-negative metals, such as gold, platinum, silver, and mercury, are rapidly precipitated from solution when added to a pulp containing galena and/or blende, and, while in the case of freshly-broken galena no increase in the flotative properties is noticeable, an appreciable enhancement in the flotative properties of the blende ensues. This enhancement is usually sufficient to bring about the flotation of fine blende particles in neutral or alkaline circuits under conditions suitable for differential galena-flotation, but not sufficient to promote flotation of coarse blende without the addition of some strong intensifier, such as acid. It has been found, however, that the addition of about 0.1 pound of copper in a soluble form to an ore containing about 14% zinc will allow the blende to float with less acid than would otherwise be required. This is of special value when treating calcitic ore, and the practice at the zinc concentrator of the Zinc Corporation may be instanced, where tailing that would require 60-70 lb. of acid per ton under ordinary mineral-separation conditions needs only 25 lb. of acid to promote blende flotation after the addition of about half a pound of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ per ton. All the copper added is precipitated and removed with the blende, so that the return-circuits are suitable for differential galena-flotation, if desired. Many of the parts of the earlier laboratory-flotation machines were constructed of copper or alloys containing copper, and small quantities of this metal passing into solution were no doubt frequently responsible for apparent anomalies between results obtained by different experimentalists. This factor probably retarded the discovery of many of the differential galena-flotation methods.

FLOTATION OF OXIDIZED ORES. So far, little has been done on a commercial scale in this respect, but at least two mills have in view the recovery of oxidized lead from dump material. As far as I know, the systems proposed include the superficial sulphiding (by H_2S , Na_2S , or similar reagent) of the oxidized galena, and the subsequent flotation of the same after the recovery of unoxidized galena and blende by ordinary methods. This method might be classed as a preferential method. It may be noted that the blende has higher flotative properties than the superficially re-sulphided lead minerals, so that the 'lead' float is the last to be taken off. Unless there is sufficient unoxidized galena to allow a primary float of this to be made, it appears as if there would be a tendency for a lot of the silver to find its way into the blende product.

CONCLUSION. I have endeavored to explain some of the

phases of froth flotation, especially as applied to local ores, from a practical point of view. Those who are closely associated with flotation work in Broken Hill will find that this paper contains nothing that is "new", but, as previously stated, any new discoveries in flotation have, to date, always been first described and published in patent specifications. Of recent years the practical side of flotation knowledge has made great strides, but many phenomena have not yet been satisfactorily explained. From time to time numerous theories have been advanced to try and explain certain flotation phenomena, but rarely, if ever, has a successful flotation process been evolved except by flotation experiments on a 'hit or miss' principle.

Strontium

Strontium is used in the form of its salts in several industries, especially in the manufacture of fireworks, drugs, and medicine. The principal salts manufactured in the United States in 1918 were strontium nitrate (SrN_2O_6) and strontium carbonate (SrCO_3), which are used chiefly in the production of red fire or light in pyrotechnics, flares, fuses, signal shells, and signal lights. Small quantities of chloride and oxalate were reported manufactured from crude ore in 1918. Many other salts were probably manufactured, but mostly as secondary products from the primary salts above mentioned. The acetate, lactate, bromide, iodide, arsenide, phosphate, and other salts of strontium are used in drugs and medicine. In Europe large quantities of oxide and hydroxide of strontium are used in refining beet sugar, but this process is not at present employed in the United States. A small quantity of strontium is alloyed with copper in making castings to free them of blow-holes caused by included gases. Fireworks and signal lights are manufactured in the United States almost exclusively near the Atlantic seaboard, and the demand for crude ore is therefore in the Eastern States. It has been difficult, consequently, to find a market for the domestic strontium ore, the workable deposits of which have so far been found only in the far West and which cannot in normal times compete in price with the celestite obtained from England because of high freight charges unless it is protected by a tariff. The known workable deposits of strontium ore in this country are in Arizona, California, Texas, Utah, and Washington. Other deposits of doubtful value occur in several other of the Western States and in a few States east of the Mississippi river. A new find has been reported from Utah, 25 miles south-east of the town of Green River, Grand county. J. T. Pardee, geologist, of the U. S. Geological Survey, reports that at this place celestite forms lenticular beds six inches thick associated with gypsum and limestone in the middle of the St. Elmo formation at the Colorado Fuel & Iron Co.'s manganese mine. Samples of the minerals are of excellent grade. In Nevada, $7\frac{1}{2}$ miles south of Goldfield, large deposits of strontianite are reported to have been discovered by G. L. Diffenbaugh, of Goldfield.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

RAY CONSOLIDATED REPORT.

The Ray Consolidated Copper Co. has published its 35th quarterly report covering the operations for the first quarter of 1920. The gross production of copper was 11,650,443 lb., as against 11,660,923 for the previous quarter. There was milled 430,000 dry tons, averaging 1.707% copper, with an extraction of 78.65%, as compared with 397,100 dry tons, 1.813% copper, and 80.66%,

The carrying price of copper was 21.96c. per pound, owing to sales being in excess of production. Since the beginning of dividend disbursements, Ray has distributed to its stockholders a grand total of \$24,229,736.

COLORADO

NEWLY CONSOLIDATED COMPANY TO MAKE ZINC OXIDE.

LEADVILLE.—The Western Zinc Concentrating Co. and Leadville Zinc Co. have been consolidated as the Western



RAY CONSOLIDATED MINE, AT RAY, ARIZONA

respectively, for the last quarter of 1919. The underground development during the quarter totaled 11,100 ft., making the grand total of such work 753,192 ft. The mining cost for the quarter was \$1.69 per ton, of which 6.075c. was the cost of coarse crushing and loading, leaving a net mining cost of \$1.63, as against \$1.62 the previous quarter. The milling cost was \$1.25 per ton. The average cost per net pound of copper produced was 16.745c., as compared with 16.574c. during the previous quarter. Miscellaneous income, including gold and silver, was equivalent to 0.445c. per pound. The total profit for the quarter was \$637,300, and after payment of a dividend of 25c. per share on March 31, or a total of \$394,295, there was a surplus of \$243,005, as compared with a deficit of \$141,364 for the last quarter of 1919.

Zinc Oxide Co., with Charles H. Collins, president; C. J. Walker, vice-president; J. B. McDonald, treasurer; and H. L. Noble, secretary. Jesse F. McDonald and E. C. Granberry complete the directorate. The company will have available for treatment one of the largest zinc-oxide orebodies in the Leadville district. It is estimated that there are 60,000 to 100,000 tons partly blocked out in the Down Town Mines property and other mines may be expected to furnish their quota. A block of 16 furnaces is being added and when completed the plant will have 34 furnaces in operation with a capacity of 100 tons daily. The new unit will be in operation by August 1 and the plant will then be the largest producer of zinc oxide west of the Mississippi river.

Contractors have commenced work on the first 350 ft.

of a 1200-ft. contract let by the National Mining & Development Co. in the Chicago tunnel, at the head of Iowa gulch. The property secured by the company consists of six claims, lying above the old Long & Derry mine. The tunnel is now in 915 ft. and is projected to cut the vein on the Ready Cash that outcrops 30 ft. wide at the surface.

The Ponsardin on the west slope of Yankee hill under lease to E. Bowden is making occasional shipments of lead carbonate and sulphide ores to the A. V. smelter. Jesse F. McDonald, general manager for the Down Town Mines, reports that several small bodies of ore recently were opened and that the company is shipping about 18 to 20 cars weekly. The Penrose mine in the Down Town basin continues fair production of iron and lead carbonate and zinc.

IDAHO SPRINGS.—A local leasing pool has opened up silver-gold-copper-lead ore on the Turner of the Freeland group. Samples assayed 1.36 oz. gold, 12 oz. silver, 45% lead, and 2.20% copper. The Newton and Hudson mills are in operation and the Combination mill is being overhauled to treat Specie mine ore. Operations are shortly to be resumed at the Refuge mine where a small force is making surface repairs and cleaning up.

GILPIN COUNTY.—High-grade gold-silver-lead ore has been opened by the Midwest company and tests made at the Iron City mill on ore from the Peru vein, gave results of 25.68 oz. silver, 0.42 oz. gold, and 69.82% lead for first grade, or \$166.83 per ton. Second-grade ore milled 3.20 oz. gold and 3.40 oz. silver; total value \$67.87 per ton at current metal prices. The Midwest is testing ore from the Cyclops dump at the Iron City mill and if proved profitable will treat the entire dump. Operations have been resumed on the Cornucopia on Silver creek. Ore is under development by a winze from the tunnel-level and a mill is planned when orebodies in the tunnel and shaft workings are further developed. Nebraska owners of the Boss tunnel, in the Quartz Valley district, have a force of men at work and have re-timbered the 1416-ft. tunnel where necessary. The tunnel is to be connected by raise with the shaft workings, that when last worked in the early 80's, produced high-grade silver ore. A sample recently taken assayed 186 oz. Denver men interested in the Spur Daisy group are constructing a shaft and power-house on the Clare Marie claim. Machinery is to be put in and the shaft, 125 ft. deep, is to be sunk to 250 ft. The group is controlled by Boston capitalists, and was a rich producing silver property in early days.

CRIPPLE CREEK.—Dividend No. 86 of the Cressen Consolidated Gold Mining & Milling Co. of 10 cents per share, \$122,000, has been declared payable June 10 to stock of record May 31. With this distribution stockholders will have received \$8,613,162. The Free Coinage Consolidated Mines Co. plans to cross-cut from the 1100-ft. level of Delmonico shaft, to traverse the Free Coinage property cutting under the Pinto shaft at 1500 ft. The cross-cut will intersect the Wilson, Pinto, and Pueblo veins of the Free Coinage system and two basalt dikes. All have produced from shaft workings, in excess

of \$2,500,000 gross from above the 500-ft. level. Bids have been advertised for 780 ft. of cross-cutting. The Delmonico shaft is equipped with powerful hoisting plant and compressor which will be used by the contractor. The Empire State shaft-sinking contract has not yet been let by Isabella Mines Co. management. The shaft is to be sunk from 1100 to 1500 ft. on this Bull Hill property.

OURAY.—A four-foot vein, new to the property, that contains 14 in. of ore sampling 428.8 oz. silver, 4 oz. gold, and 36% lead has been exposed by a cross-cut in the Hidden Treasure tunnel. The property, owned by the Walsh estate, is controlled by Mrs. E. B. McLean, daughter of the late Thomas Walsh. This is the second vein uncovered since work was resumed. Approximately 700 tons of ore, now stored, will be shipped as soon as road conditions permit. Half of the ore mined from the first Hidden Treasure vein is of smelting grade. A four-foot vein of silver-bearing quartz has been uncovered just below the surface on the Silver Spur property on the Slide vein extension, west on the Silver Spur property below town, by Mitchell and Zanin, of Ouray, operating under bond and lease. Contractors have commenced work on a 500-ft. shaft-sinking contract recently let by the Mountain Top Mining Co. Nine men are employed on the work.

GEORGETOWN.—New machinery will be placed in the mill of the Liberty Mines Co. at Argentine Pass and operations are to be resumed in the Pennsylvania mine in charge of E. LeNeve Foster, recently appointed general manager. Ore from the Turner mine at Freeland, under lease to B. A. Hedley, of Clear Creek county, from a 14-in. streak, assays 70% lead, 2 oz. gold, and 2 oz. silver.

MICHIGAN

QUINCY IS STOPPING ON THE 77TH LEVEL.

HOUGHTON.—While the deal has not been actually concluded, the terms have been arranged and all details have been completed for the transfer of the Michigan Land & Iron Co. interests to Henry Ford and associates of Detroit. This involves 32,000 acres of upper-peninsula territory in Baraga, Houghton, and Iron counties. It comprises large tracts of hardwood timber land, with some mineral prospects, including two partly explored iron-ore deposits and a good deal of frontage on Lake Superior. The consideration runs into millions of dollars, it is reported.

The Michigan Land & Iron Co. is owned in England. Eighty-five per cent of the stock belongs to Lord Brassey. Originally the land was secured through some grants that were made in the early days of railroad-building in the upper peninsula of Michigan. The original Marquette, Houghton & Ontonagon railroad, now included in the Duluth, South Shore & Atlantic system, which company, in turn, is dominated by the Canadian Pacific interests, issued a large amount of bonds for its first financing. Covering the bonds was a land mortgage which the Brassey interests later found it necessary to take over. This land has been held by the Lord Brassey

people for 45 years. The Brassey interests are actively associated with mining developments in many parts of the world.

The Quincy's development of the east branch of the Pewabic lode continues to be the most encouraging sign for the future successful operation of this property. While the so-called east branch has not been extensively opened in the most northerly shaft, on the other hand, in the southerly shaft, at great depth, in No. 2, is shown the best copper 'rock' of any of the openings. At the extreme depth on the 73rd and 77th levels, both north and south of the shaft, the stopes are in good material. North of the shaft the lean zone from the 74th to the 77th levels, formerly opened in a kind of 'rock' which

the sale of 30,000 acres of timber land in Keweenaw county has not been completed as yet, but the details have been arranged and the announcement is expected at any time.

NEVADA

INTERESTING LAWSUIT INVOLVES THE WALL STREET COPPER COMPANY'S PROPERTY.

COPPER CANYON.—George B. Thatcher, former attorney-general of Nevada, and associates plan to sell to George Wingfield the Homestake and Guy Davis placer claims in the Copper Canyon district, 20 miles south of Battle Mountain. Engineers have estimated the claims to be worth \$200,000 to \$400,000. The claims were



WARD, COLORADO

had every indication of going from bad to worse, now shows signs of improvement. Good stopes which were opened in January and February now are getting into better ground. Quincy's No. 6 shaft has opened stopes on the east branch and in the foot of the east branch produced rock of a quality that is better than the average of the Pewabic in the levels above the 73rd. In the 75th level, on this same east branch, is found the best-looking rock that now is coming from No. 6. This shaft is now being sunk below the 77th, which is the bottom level. Stopping is under way on the 77th.

Copper shipments continue by railroad and by boat from the Calumet & Hecla docks. The rail shipments are for foreign export. There is not likely to be an increase in production of copper from the Isle Royale mine this month, owing to the fact that the shipments have been just enough to keep the three-head Isle Royale stamp-mill operating. Hancock shipped 1000 tons of rock last week, Superior 900 tons. Keweenaw's deal for

located in 1913. The locations covered the lode claims Glasgow and Western, and this company secured an injunction restraining the prospectors from working the placer ground. The prospectors interested Thatcher and he fought the case for six years, finally securing a decision in his favor from the Supreme Court. When this decision was given the prospectors had all sold their interests to friends of Thatcher, principally State officials. There is no water flowing in the canyon, but other conditions are good, as the bedrock is smooth and there are few boulders. Shafts are being sunk to put the claims in condition for an examination by one of Wingfield's engineers. The bedrock is 40 to 50 ft. from the surface and the gold is found over an average width of 125 ft. The claims extend along the canyon 2400 ft. Where the channel is narrow the average value of the sand from the surface to a point three feet above bedrock is said to be 75c. and in several places on bedrock assays of as high as \$50 per yard have been secured. No attempt has been

made to secure a close estimate of the average value per yard of the deposit.

TOLICHA.—A 12-ft. width of gold ore assaying \$50 has been found in a 115-ft. tunnel cutting at shallow depth a vein in the Landmark group, being worked by T. A. Harney of Chicago and associates. In another vein in this tunnel there is a 17-ft. width that assays \$18. The Landmark is near the three Life Preserver claims that were developed under option several years ago by George Wingfield. Wingfield relinquished his option because of the refusal of the owners to extend the time and little work was done in the district until Harney secured an option on the Landmark several months ago. The vein material is silicified rhyolite 5 to 20 ft. wide, with rhyolite walls. Most of the ore assays \$25 to \$50, but rich ore has been found by Harney in the last month. Air-drills are used and six miners are employed. Drifts are being driven from the tunnel and a shaft will be sunk and the ore blocked out in preparation for the erection of a mill. The ore is not refractory and tests may be made with a pan-amalgamation plant. Tolicha is 50 miles south of Goldfield and is 12 miles from a railroad.

SPRUCE MOUNTAIN.—The 30-ton smelter of the Bulls-head Mining Co. in the Spruce Mountain district of Elko county is to resume treating silver-lead ore from the Bullshead mine, and custom ore. A water-jacketed furnace is used and the fuel is 60% mountain mahogany, plentiful in the vicinity, and 40% coke. The smelter when operated last fall produced at a rate of ninety 100-lb. bars of bullion in 24 hours. The average value of the ore treated was \$45 per ton. The district is in the Spruce Mountain range and heavy snow makes the hauling of supplies and ore difficult in the winter. The mine and smelter will be in charge of Walter Palmer, a professor in the Mackay School of Mines at the University of Nevada.

AUSTIN.—Hubert W. Rast has contracted with a San Francisco paint company for the output of ochre from his mine near Walters station on the Nevada Central. Ochre, the earthy form of hematite or limonite, is used as a pigment in the manufacture of paint. The price to be paid Rast is \$30 per ton f.o.b. Walters station. The ochre is found in veins containing seams of silver-lead ore.

GOLDFIELD.—The case of M. B. Aston against C. R. Evans, congressman from Nevada; A. H. Howe, a Reno broker, who formerly was secretary for the Goldfield Consolidated, and W. S. Norris, connected with several Nevada mining companies, is to be tried in the district court here. Alleging deception and fraud, the plaintiff seeks to recover 37,500 shares of stock in the Wall Street Copper Co. and a share in the war-time profits of the company. Aston claims the net sum due him is \$60,000. The 'shooting' of the drill-holes so that he could not enter the mine, the covering of faces of good ore with broken material, and similar tactics are charged against the defendants in the complaint in what Aston claims was a successful attempt to secure his interest for \$15,000. The complaint says Aston sold his interest in 1913. The defendants in their answer deny all of the material alle-

gations. Well-known lawyers have been employed by both sides and it is rumored that much 'dirty linen' will be washed during the trial. The plaintiff claims \$625,000 as the gross value of the ore produced. The defendant places this amount at \$600,000 and the expenses at 'over \$467,000'. These figures are for the output from June 10, 1916. Ore from the Wall Street was taken from the mine by pack trains and then loaded into wagons and hauled to the railroad.

VIRGINIA CITY.—The United Comstock Mines Co., capitalized for 5,000,000 shares, par value \$1, has been organized to build a 1000-ton mill to treat low-grade ore from the Gold Hill mines of the Comstock. Bulkeley Wells, president of the American Mining Congress, George Wingfield, and Herbert Humphrey are said to be the main factors in the company. The upper levels of the Gold Hill mines have been re-opened and sampled and it is reported that several well-known engineers have approved the plans to treat the ore on a large scale. A complete statement is expected in a short time from the new company. This will be the second attempt in Nevada in recent years to treat on a large scale low-grade gold ore in old mines. The first was the Goldfield Development Co., operating the Consolidated mines at Goldfield. This company, after over a year of financial difficulty, is to start early in June ten stamps of the 1000-ton mill. The objective is the treatment of 1500 tons of \$5.60 ore daily. The fate of the McFadden bill is of importance to Virginia City and Goldfield, as in both places there are millions of tons of gold ore that can be treated at a good profit if a better price can be secured for the metal.

COMO.—The Como Consolidated company is treating daily 100 tons of gold-silver-copper-zinc ore assaying \$10 to \$12, and bullion shipments are being made at a rate of \$25,000 to \$30,000 per month. At a special stockholders' meeting, at which 932,000 of a total of 998,000 shares was represented, it was decided to issue 35,000 shares of preferred stock at \$10 to pay for the recently acquired claims of the Buckeye Gold & Silver, Rapidan Silver, Mountain Belle, and Palmyra Tunnel Gold & Silver companies. The purchase of the claims of the last gives the Como a tunnel 4500 ft. long that can be extended to cut the Buckeye and Rapidan veins at a depth of more than 600 ft., or 300 ft. below the present workings. Part of the funds from the stock issue will be for equipping and continuing the tunnel. The driving of the tunnel into the veins will eliminate expensive pumping. The Buckeye shaft has levels at 115, 200, and 300 ft., the drifts reaching a depth of 50 to 75 ft. more than the shaft levels. The average width of the vein is 10 ft., with an extreme width of 50 ft. A drift has been driven 175 ft. north-east on the bottom level without reaching the limit of the ore-shoot, which is 12 ft. wide at the face. Some of the material in this drift is unusually rich in silver and gold. Drifts south-west from the shaft have opened ore for 875 ft. The vein in the Rapidan, north of the Buckeye, strikes almost at right angles to that in the Buckeye. The inclined Rapidan shaft is 350 ft. deep. An ore-shoot of an average width of 10 ft. has been

opened for 775 ft. on the bottom level and ore is now being broken for a width of 15 ft. in a stope north of the shaft. The average value of the Rapidan orebody is estimated to be \$10 to \$12. In the Lucky Sunday, southeast of the Buckeye, ore of higher than average grade is being developed at a depth of 100 ft. This shoot, 5 to 10 ft. wide and assaying \$75, had been opened for 135 ft. when work was temporarily discontinued recently because of the poor condition of the road to the mine.

NEW MEXICO

CHINO COPPER CO.'S REPORT.

During the first quarter of 1920 the Chino Copper Co. milled 413,900, equivalent to 4548 tons per day, as against 4832 tons per day for the previous quarter. The

a deficit of \$161,858 during the previous quarter. Earnings for the quarter were computed on basis of 21.88c. per pound for copper, due to sales being in excess of production. The steam-shovels at Santa Rita moved a total of 569,479 cu. yd. of stripping during the quarter.

UTAH

PRICE OF SILVER IS HURTING UTAH MINES.

SALT LAKE CITY.—The decline in price of silver to the \$1 mark has caused considerable uneasiness among the silver-lead mining men of the State. There is no question but that \$1 per ounce is a good price for silver under normal conditions, but right now conditions are far from normal and \$1 is little better than was 50c. some years ago. The mining industry is struggling along



THE TONOPAH DIVIDE MINE

average grade of the ore was 1.83% copper, as compared with 1.77% for the last quarter of 1919. The total quantity of copper produced was 10,621,276 lb., as compared with 9,821,729 lb. for the last quarter of 1919. The recovery per ton of ore milled for the first quarter of 1920 was 25.66 lb., as against 22.09 lb. for the last quarter of 1919. The concentrate production was 32,606 dry tons, averaging 16.29% copper, as compared with 31,641 tons and 15.52% copper for the previous quarter. The cost per pound of copper produced, including all charges except Federal income and excess profits tax, was 14.62c. per pound, as compared with 18.65c. for the last quarter of 1919. Allowing for gold and silver credits and miscellaneous income, totalling \$72,122, or 0.71c. per pound, the net cost of production was 13.91c. The total profit for the quarter was \$809,727, and after payment of a dividend of 37½c. per share, or a total of \$326,243, the net surplus was \$483,485, as compared with

under serious handicaps of high taxes, inefficient and high-priced labor, and greatly increased costs of every item entering into mining, milling, and smelting. Not only this, but a decline in the price of silver means a smaller production, because ore that could be marketed at a profit with silver above \$1.25 per ounce, must now be left in the mine. Utah ranks third among the silver-producing States in the Union, and the decline has caused heavy losses to the large operators. For instance, the Chief Consolidated mine at Tintic is suffering a loss of between \$70,000 and \$80,000 per month by reason of the decline, as compared to the prices of silver prevailing at the beginning of the year. Other mines in Tintic and Park City are suffering in like manner.

Announcement was made on May 27 by Carl A. Allen, district engineer of the Bureau of Mines, that the date for mine-rescue and first-aid contests at Denver have been postponed from August 20 and 21 to Sep-

tember 9, 10, and 11. The contest this year will be international in scope, teams from Canada and Mexico competing. It is expected that Utah will send at least five teams to the contest from the Utah Fuel Co. and United States Fuel Co.'s forces, and one each from Bingham, Park City, and Eureka.

PARK CITY.—J. D. Fisher, superintendent, reports that a full face of ore is exposed on the 1700-ft. level of the Naildriver mine, with every indication that a permanent body has been cut. On the 1500-ft. level an orebody is being developed that assays as high as 85 oz. silver per ton. The wagon-road to the property has been shoveled out and workmen are now engaged in building a culvert to take care of the water that has been diverted from its channel by the Ontario dump and doing considerable damage to the road. Soon after June 1 shipments will be started.

Ore shipments from the district for the week ended May 22 totaled 2263 tons, as against 2397 tons for the previous week. The Judge Mining & Smelting Co. shipped 655 tons; Silver King Coalition, 542 tons; Ontario, 512 tons; Daly-West, 175 tons; Daly, 155 tons; and the Judge smelter, 112 tons of premium spelter.

The ore encountered recently by the Silver King Consolidated company in its Spiro tunnel is described as occurring in a series of parallel stringers of galena crossing the tunnel a foot or two apart. The galena is high-grade and looks almost like the ore in the old shaft workings. While it is inferred that the stringers across the tunnel proceed from a mineralized fissure, the management does not believe the fissure to be one of the large bonanza veins which are the objective of the tunnel development. In this development the company is handicapped by the water which continues to flow from the breast, the broken-up character of the ground, and the difficulty of securing competent miners. The broken ground, although it slows down the work, is just the formation in which the probability of large orebodies is greatest. The tunnel is at present in more than 12,700 ft., and it is expected that another 250 or 300 ft. will bring it to one of the major south-west veins of the district.

EUREKA.—During the first quarter of 1920, the Chief Consolidated Mining Co.'s development work totaled 6298 ft., comprising drifts, raises, and winzes. The new No. 2 shaft was sunk a distance of 221 ft. during the period. Ore shipments totaled 22,096 dry tons, from which was produced 1518 oz. of gold, 651,453 oz. of silver, 2,911,174 lb. of lead, and 40,216 lb. of zinc. The silver-lead crude ore averaged 0.066 oz. gold, 28.33 oz. silver, and 11.5% lead. The average gross value of all ores was \$49 per ton, and after deducting smelting, freight, and sampling charges of \$19.82 per ton, the average net value was \$29 per ton. After payment of smelting, transportation, and sampling costs, the income from the above output was \$678,072, while the net profit for the quarter was \$188,522. A dividend of 10c. per share was paid, totaling \$88,423. Conditions in the mine are reported as being in a most satisfactory condition.

Shaft No. 2 is now being sunk at the rate of five feet per day. It is close to the 1400-ft. level, and has been in porphyry up to the present time. It is thought the shaft is nearing the limestone, in which formation better progress is anticipated.

Ore shipments from this district for the week ended May 22 totaled 141 cars, as against 170 the previous week. The Chief Consolidated shipped 39 cars; Tintic Standard, 20; Dragon Con., 13; Eagle & Blue Bell, 13; Iron Blossom, 8; Victoria, 7; Mammoth, 7; Grand Central, 6; Iron King, 5; Gemini, 5; Bullion Beck, 4; Centennial Eureka, 4; Colorado, 4; Empire, 2; Alaska, Godiva, Ridge & Valley, and Victoria Con., each 1 car.

The large boarding and lodging house at the property of the Tintic Empire Co. in the northern part of the district was recently destroyed by fire. The fire had made considerable headway before it was discovered, so that the occupants of the building lost all of their personal effects. The other buildings belonging to the company in that vicinity were saved.

The Ruby shaft of the Knight Drain Tunnel Co. is nearing the 600-ft. level, with conditions favorable for rapid sinking. The work is being handled under contract, and while the first few hundred feet were expensive, owing to the water developed, better progress is now being made. At the Big Hill property, development work has reached an interesting stage. A shaft has been sunk to the 600-ft. level, and a drift started which has for its objective one of the most important veins in that section of the district. This drift has been driven a distance of 200 ft., and after cutting across the vein, it is the intention to follow it both north and south, as the company officials expect important disclosures at points where it is intersected by east-west breaks.

AMERICAN FORK.—There is considerable activity this spring in the American Fork district. The roads have been cleared of slides and rocks and are in good condition as far as the Wild Dutchman mine. Mining outfits are going up the canyon nearly every day and many properties are working moderate forces, among them being the Belorophon, Lone Pine, Silver Flat, Treasure Hill, Pacific, and Silver Dipper, while the South Park, Pittsburg, and Silver Lake properties will shortly begin development work. The Belorophon is in good condition. Although the drift is about 20 ft. from the vein, every seam is full of lead and copper. The Pittsburg and Utah Centennial properties are both in shipping ore, but have been idle during the winter. At the Pacific mine, ore has been mined for several weeks past. A silver-copper stope has been opened, while a stope of lead milling ore is about ready for mining. There is a mill at this property, and operations are expected to be resumed before long.

BRITISH COLUMBIA

CONSOLIDATED M. & S. CO. PLANS TO DEVELOP COPPER PROPERTIES.

VICTORIA.—The fact that the Consolidated Mining & Smelting Co. proposes becoming one of the large copper

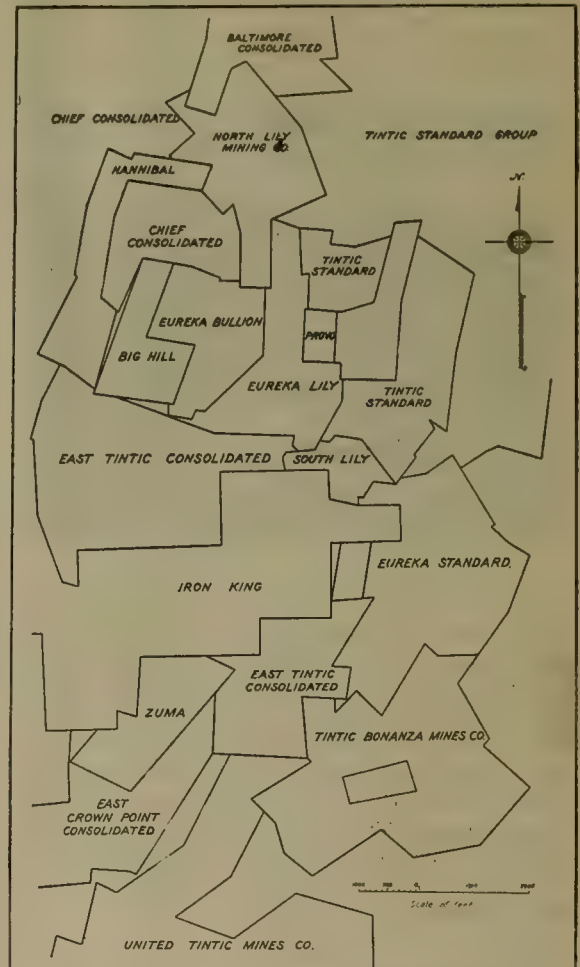
producers of the Province is becoming evident. The company has been laying the foundations to this end for some time. It has two large copper deposits on Vancouver island under development, one being the Old Sport, situated on Elk lake near the south-east arm of Quatsino sound, and the other the Sunloch, at Jordan river not far from Victoria. Through surface work, diamond-drilling, etc., some 1,500,000 tons of copper ore, approximating 1.8%, has been proved on the former property and it is authentically reported that reconnaissance surveys have been made of a number of railroad routes to tidewater. The company recently acquired control of the Sunloch where it is estimated that 2,500,000 tons of proved ore, averaging between 1 and 2% copper per ton, has been blocked out. The Big Interior group also has been bonded. It is situated at the head of Great Central lake at an altitude of 6200 ft. This season's work will consist of the securing of all possible information regarding its possibilities, the topography and geology of the area being investigated with a view to establishing the practicability of working the deposit from about the 1500-ft. level. If this can be done the problem of making a mine will be simplified. As to transportation, the E & N railway is to be extended from the town of Alberni to the south end of Great Central lake so that it will be a matter of running the ore down the mountain to the water, loading it in scows for transport over water for 22 miles, and dumping it in waiting freight cars for removal to the point selected for treatment. The Tidewater Copper Co. at Sidney Inlet is proceeding with the opening up of its deposits with satisfactory results. There are at least 500,000 tons of $1\frac{1}{2}$ to 2% copper ore proved with good prospects of larger quantities being developed as work continues.

Neither the Granby Consolidated Mining & Smelting Co., Hidden Creek, nor the Britannia Mining Co. are working up to capacity at present. In the old workings of the Britannia it is roughly estimated that there are 9,000,000 tons of ore in reserve and on the Victoria claim, under development, it is calculated that there are a possible 5,000,000 tons.

VANCOUVER.—By the staking of a mineral claim within the municipality of Point Grey and demanding that he be given title under the Mineral Act, James Adair, a prospector, has presented the Provincial government with a problem that promises to be difficult of solution. Adair asserts that he has a good showing of ore in a section, the residential popularity of which has given property considerable value. The terms of the Act, it is said, have been fully complied with but Adair's application for the completion of the record has not yet been approved. He declares that it is his intention to press the matter so that the courts may have an interesting point to settle.

STEWART.—It is reported that the line of railway up Bear river in the Portland Canal district is to be repaired and operated this summer. The Algonquin Development Co., Ltd., is reported to have made an arrangement with the Canadian Northeastern Railway Co. under the terms

of which the long deserted line will be put in shape and used for the transportation of supplies and equipment during the season. The work involves reconstruction of the Bitter Creek and Bear River bridges, clearing a right of way, etc. Tenders are being called for. The Northern Light property is actively under development and diamond-drilling is to be undertaken as soon as weather conditions render it feasible. Five thousand feet of this



MAP SHOWING PROPERTIES IN THE TINTIC DISTRICT, UTAH

work is planned. There has been much activity in the transport of supplies to the Spider property, Salmon river. Hauling was done on Yukon sleighs. A temporary camp has been established and a compressor-house is under construction. A three-drill compressor and engine is being placed. The tunnel-site is being cleared of snow and drilling will commence in a few weeks.

ALICE ARM.—The men who were sent by the Taylor Mining Co. to replace those on strike at the Dolly Varden mine, sided with the strikers on arrival, and refused to go to work. A more recent dispatch states that the strike is settled, but does not give the terms of the agreement. The McLennan Silver Mines, Ltd., has bonded the Royal

group of seven claims, adjoining the Dolly Varden property.

Clyde A. Heller, of the Tonopah-Belmont Development Co., and George H. Garry, geologist, recently visited the Belmont-Surf Inlet property. The Belmont company has purchased the Primrose Royal group, near the Surf Inlet property, and will start development at once. Like the Surf Inlet mine, the ore contains gold, silver, and copper. The main value of the ore is in the gold.

PRINCETON.—Trains are again running between Princeton and Allenby on the Copper Mountain branch

Strong protests have been made to the Government in the hope that the tax may be modified.

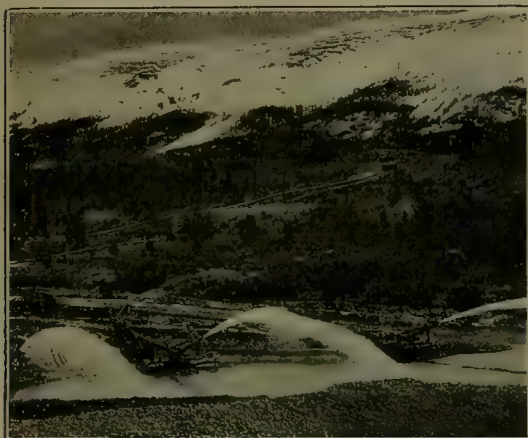
PORCUPINE.—There are renewed complaints of the shortage of labor and the restless uneasy disposition of the miners here. The output of the Hollinger Consolidated is stated to be declining, the tonnage treated having dropped to about 1700 tons daily as compared with the average of 1950 tons during 1919. Were they available the staff would be increased by 300 or 400 additional men. With a continuance of these conditions there is little prospect that the old dividend basis of 1% per month will be restored this year. The directors of the Clifton-Porcupine have laid out extensive diamond-drilling and contracts for several thousand feet of this work will be let immediately. Cross-cutting and drifting on vein No. 7 on the 200-ft. level are stated to have been attended with satisfactory results. The North Crown, the new company which has taken over the Porcupine Crown and Thompson-Krist, is asking for tenders for 1000 ft. of cross-cutting on the 500-ft. level to explore sections of the property lying west of the main vein. A good tonnage of milling ore is in sight at the 100-ft. level, from which the mill is being supplied.

MATACHEWAN.—Diamond-drilling to the depth of 1000 ft. has cut ore of good grade near No. 2 shaft of the Matachewan (formerly the Otisse). At No. 1 shaft a large tonnage of ore has been blocked out. The company is making preparations for the erection of a mill, the first unit of which will have a capacity of 100 tons per day. The Lake Matachewan, adjoining on the northeast, is preparing to explore what is believed to be an extension of the Matachewan's orebodies.

COBALT.—The Nipissing Mining Co. resumed shipment of bullion during the last week in May after having stored its silver for nearly two months. With quotations at around \$1 per ounce, plus exchange of from 10 to 13% on New York funds, the gross return is about three times as great as the cost of production, which during 1919 amounted to a little under 36c. per ounce.

Shortage of labor is becoming the outstanding problem which the Cobalt mining companies now appear to be obliged to solve. High wages in outside industries is gradually inducing men to leave, and at the majority of the mines the shortage is felt. The International Nickel Co. sent a representative to the silver camp and is offering wages a little higher than the Cobalt schedule. Meantime, the Cobalt companies have not intimated any intention to enter into competition in bidding against outside industries. They continue to pay the usual wage.

The Coniagas company is now drawing ore from its recently purchased Trethewey mine, and the investment should prove to be a profitable one. The Coniagas has also commenced work on a group of claims in the Gowganda district which were recently acquired under a working option agreement. Production from the La Rose Consolidated is heavier than during the corresponding period one year ago. Ore is being drawn from four of the company's properties, namely: the La Rose itself, the Violet, Princess, and University.



HYDRAULICKING IN BRITISH COLUMBIA

of the Kettle Valley railway, but the construction work between Allenby and Copper Mountain is again tied up by another strike. The Canada Copper Corporation had expected to commence the shipping of concentrate to the Trail smelter in August, but how long the strike will delay the date is not known. Except for continued labor trouble this property would have been shipping and employing between 400 and 500 men several months ago. H. R. Van Wagenen, general manager for the company, has returned to Copper Mountain, after spending the winter at Denver.

ONTARIO

LABOR SHORTAGE SERIOUS AT COBALT AND PORCUPINE.

TORONTO.—On May 19 new taxes, seriously affecting the Canadian mining industry, were imposed. The war customs duty of 7½% was abolished, and the business profits tax considerably modified, profits not exceeding 10% per annum being exempted. The new imposts include a tax of 1% on all sales by manufacturers, wholesalers, jobbers, or importers (with the exception of sales of essential food, coal, and goods for export). The most drastic change affecting the mining industry is the imposition of a stamp tax of 2c. per share on each share of stock transferred, irrespective of the value of the stock, which will hit the smaller companies hard and, in the opinion of the mining brokers, will greatly curtail transactions and hinder the formation of new companies.



ALASKA

The wages paid to employees of the mines and mills in Alaska vary to some extent, being higher at Kennecott and Latouche, where expenses are greater than in the vicinity of Juneau where living costs less. One of the largest companies operating in the Juneau district maintained an average daily scale of \$4.87 during 1919 for eight hours, charging \$1 per day for board. At Kennecott and Latouche the average wage at present is above \$6, which includes a bonus of \$1.75 which will continue at least until July 1 of the present year, this bonus being based on the price of copper. Board at the latter places is charged for by the companies at \$1.60 per day, hospital charges 8 cents per day. Steady work is furnished by all the metal-mining industries of the Territory and all the employees are satisfied with the wages and accommodations. There are no labor troubles in any of the mining camps of the Territory.—The Cliff mine, near Valdez, from which gold to the value of nearly a million dollars had been taken previous to the closing down a few years ago, has been re-opened and will be operated. Other properties in the same locality are being prospected with a view to operating. At letter from Nome suggests that the tin deposits of that locality may be exploited soon. A shaft is to be sunk to a depth of 1000 ft., and cross-cuts will be run. If the property shows up as well as it is believed, a plant will be built.

CALIFORNIA

Calaveras County.—Unwatering of the Lightner mine shaft is progressing, and lateral work will soon be undertaken. The shaft will be sent several hundred feet deeper and new levels opened. The Lightner for many years ranked among the premier gold producers of the Mother Lode and is excellently equipped.

Nevada County.—All units of the 80-stamp mill of the Empire Mines Co. are now in operation and it is reported that satisfactory results are being obtained. No milling is being done at the Pennsylvania plant, the two having been consolidated. The underground crews of the Empire mine continue insufficient and very few men are applying for positions.

Plumas County.—It is reported that the Engels Copper Co. is negotiating for the purchase of the Thompson smelter from the Mason Valley Mines & Smelter Co. The plant is near Yerington and ranks among the largest copper plants in the West. The Engels company is the largest active copper-producing corporation in California, and operates important mines and a large flotation plant on the Plumas copper belt. It is further reported that a reverberatory furnace will be added to the two blast-furnaces for smelting of concentrate and custom ores.

Trinity County.—The Globe mine here will resume operations after lying idle for the past few years. A body of ore has been opened which is of sufficient extent to justify running the mill under present prices for labor and supplies. The Globe is one of the best equipped mines in the State in point of milling facilities. It recently changed hands, and the new owners have been running tunnels for the purpose of developing ore. A few years ago the mine

employed nearly 100 men.—The Democrat mine has been sold by Junkans, Hanna & Ryan, local men, to H. E. Markley and L. Evans, of Marysville. The new owners have already put men to work clearing out the tunnels and getting the property in shape for operation. A mill is on the property. The ore in the Democrat carries free gold and is rich. The property lies on the dividing ridge between West Weaver creek and Democrat gulch, both of which were rich in gravel gold.

The mill at the Globe mine, near Dedrick, is being started up. A large quantity of ore averaging around \$20 per ton is in sight. The mill has been idle for several years. A. B. C. Cousin is superintendent. The Globe mine is at an elevation of 6500 ft. The mill is 2000 ft. lower, mine and mill being connected by a tram 6500 ft. in length.

COLORADO

Ouray.—There is marked activity in the district, and numerous properties are now shipping; production will increase as weather conditions become more favorable. As the ores of Ouray are rich in silver, a steady market for this metal ensures prosperity for Ouray.—Carney and Kelleher have resumed operations on the Wedge, and are working over the old dumps. Shipments are being made.—Luna and Eckman continue to operate the Wedge through the Bachelor Keedive tunnel, getting out a rich silver ore.—The Black Girl is now being put into condition to ship. An output of 10 cars per month is anticipated.—McCarthy and Smith have leased the Wyoming, located near Red Mountain.

The White Cloud Mining Co. is opening up a three-foot body of ore, containing silver, lead, and copper.—The Hidden Treasure has a large amount of ore broken, which will be shipped as soon as the trail is passable.

Silverton.—The snow still remains in large drifts, seriously impeding operations, but the warmer weather of the past two weeks will no doubt result in rapid melting. Many of the mines have a heavy tonnage of ore broken ready for shipment.—The Gold King Extension Mines Co. has a large quantity of ore broken, and 20 cars of concentrate ready to ship as soon as the Gladstone branch of the Silverton Northern railway is opened.—W. Harrison will probably resume operations on the Pride of the West property, which has been idle for a year.

Lessees on the Ridgway have opened up a good vein of gold-silver ore, and shipments will be made this season. The Ridgway is an old producer, owned by the bondholders of the Eureka Exploration Co., but has not been operated for several years. Bonner & Co. carried on extensive development in 1914.—The Grand Meadows group, situated at Animas Forks, is being developed.—The Dives Leasing Co. and the Highland Mary have several cars of ore ready to pack out.

IDAHO

Coeur d'Alene.—The Hypotheek Mining & Milling Co. has cut a vein 170 ft. from the portal in its new tunnel. The vein has been penetrated for six feet and the drill-holes indicate that it must be wider. It contains only a little ore at the point of intersection; but the appearance

of the vein matter is good.—According to a report from Kellogg, ore has been found in sinking a shaft at the Yankee Boy mine. A carload of high-grade ore is said to be ready for shipment. A long cross-cut tunnel will develop the Yankee Girl property.

Lemhi County.—An electric-light and power plant is being installed on French creek, on the upper Salmon river, below Florence, to light the placer ground being developed. It is planned to run a power-line to the rich gold-quartz mines in the Bear Creek and Mount Marshall districts, which are being successfully operated and are shipping bullion from time to time. Mount Marshall lies on the south side of Salmon river, and the veins are regarded as a continuation of the lodes traversing the Buffalo Hump district, on the north side of the river.

Mackay.—Profitable mining from almost the first day of work has been possible upon the property of the Doughboy Mining & Leasing Co., situated five miles north-west of here, according to Arthur N. Sweet, consulting engineer. This property, consisting of four claims, was acquired by the Doughboy company only eight weeks ago. Now that the company has been organized the shaft will be sunk to a depth of 500 ft., and 1000 ft. of drifting on various levels will be done. The car of ore now on its way to the sampler averages 35% lead and 33 oz. silver per ton. At the bottom of the shaft, at a depth of 240 ft., there is 4½ ft. of ore, a sample of which averaged 65% lead and 69 oz. silver, according to Mr. Sweet.

MONTANA

Butte.—The Jardine Mining & Milling Co. has resumed operations under the management of H. C. Bacorn. Forty stamps are operating on a high-grade gold ore. The ore-bodies already blocked out are said to be extensive. Satisfactory milling results are being obtained. This property is located 6 miles from Gardiner. Twenty-one of the 26 claims owned by the company are patented. Present plans are for the treatment of 400 tons daily. Tungsten is also an important product of milling operations.

Neihart.—The Cascade Silver Mines Co. is now milling between 200 and 250 tons of ore per day; 30 men are working three shifts. The mill concentrate assays 40 oz. silver per ton. An old dump running 10 oz. of silver is also being re-worked.

NEVADA

Gold Circle.—The Gold Circle Queen is making fair progress in sinking its shaft from the 230 to the 330-ft. level, a greater amount of water than was expected interfering somewhat. A telephone line has been run for 2½ miles to connect the camp with the main line. R. S. Bolam is general manager.

Leadville.—The Leadville Mines Co. has cut on the 500-ft. level a vein in which six inches assays 280 oz. silver and 45% lead, while a sample over four feet assays 40 oz. silver. A test-run of the mill indicated the desirability of certain changes which are now finished. High-grade ore taken out in the development of the new vein is being sacked for shipment. A motor-driven compressor and hoist are being put in underground.

YUKON

Dawson.—The Yukon Gold Co. started its hydro-electric plant on May 26, and its fleet of dredges is in full operation. Individual miners have started to wash pay-ore that has been won during the long winter months.—After a long preamble, the following resolution was passed by the Yukon council, recently: "Be it resolved that in the opinion of this council the salary and living allowance of the gold commissioner, G. P. Mackenzie, should be increased substantially, and that in addition the Government should make provision for him to occupy government house."

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

J. O. Greenan, of Mina, Nevada, is at Berkeley.

H. R. Plate has left for New York, to be gone about two weeks.

F. W. Denton, of Cambridge, Massachusetts, is at Painesdale, Michigan.

L. C. Graton is with the Calumet & Hecla Mining Co., at Calumet, Michigan.

James M. Platt has left Mexico City and is now at Santa Barbara, California.

Oscar Lachmund, of Spokane, is leaving for the Orient on professional business.

Howard W. Fitch was married on June 2 to Miss Mary Marshall of Salt Lake City.

C. W. Beauchamp has become mill-foreman for the Harmony Mines Co. at Baker, Idaho.

Herbert C. Enos is assistant-general manager for the El Oro Mining & Railway Co., at El Oro, Mexico.

Frank L. Stack has left for Mexico to accept a position with the Santa Gertrudis Mining Co., at Pachuca.

R. F. McElvenney, manager of the Garfield smelter of the A. S. & R. Co., has returned to Utah from New York.

O. M. Kucks, general manager of the International smelter at Tooele, has returned from New York to Salt Lake City.

W. O. North has left Nevada to accept a position as consulting engineer to the La Fe Mining Co., at Guadalupe, Mexico.

E. N. Wanamaker and **E. A. Reinoso**, of the research department of the Anaconda Copper Mining Co., were in Utah recently.

Robert T. Hill has joined **J. Edward Brantly** and **R. S. McFarland** in a partnership as geologists and engineers at Dallas, Texas.

Henry Lyne, for many years head of the ore-purchasing of the A. S. & R. Co. at Denver, has been taking a holiday at Santa Barbara.

Thomas Carmichael, who has been connected with the Chief Consolidated Mining Co. for a number of years, has been appointed treasurer of the company, to succeed **W. P. Seager**, deceased.

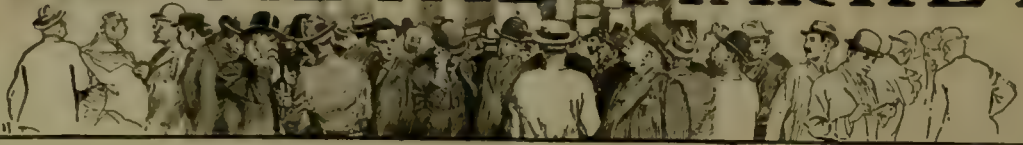
H. C. Plummer, formerly assistant-superintendent of mines for the Cananea Consolidated Copper Co., at Cananea, is now superintendent for the Arizona Commercial Mining Co., at Globe, Arizona.

Chas. Butters & Co. has opened offices at 90 West St., New York, to be under the direction of **F. L. Bosqui**. Also at Salt Lake City a complete engineering and ore-testing laboratory has been opened under the supervision of **A. H. Jones**.

A. C. Boyle, Jr., for the past ten years Professor of Mining, Metallurgy, and Economic Geology in the School of Mines, University of Wyoming, has resigned to accept the position of geologist for the Union Pacific Railroad Co. For the present he will be stationed at Laramie.

Frederick G. Cottrell, recently nominated Director of the U. S. Bureau of Mines, received the Willard Gibbs medal from the Chicago section of the American Chemical Society. This medal, named for a distinguished American scientist, was founded by **William A. Converse**, of Chicago, and is conferred in "recognition and encouragement of eminent research in theoretical and applied chemistry".

THE METAL MARKET



METAL PRICES

San Francisco, June 1

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10
Copper, electrolytic, cents per pound.....	19
Lead, pig, cents per pound.....	8.75-9.75
Platinum, pure, per ounce.....	\$95
Platinum, 10% iridium, per ounce.....	\$130
Quicksilver, per flask of 75 lb.....	\$80
Spelter, cents per pound.....	9.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

May 31.—Copper is inactive and steady. Lead is quiet and firm. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.85 pence per ounce (925 fine) calculated at the normal rate of exchange.

New York		London		Average week ending	
Date	cents	Date	pence	Cents	Pence
May 25.....	102.00	59.50	Apr. 19.....	118.12	68.41
" 26.....	102.25	59.87	" 26.....	117.87	69.08
" 27.....	102.00	59.37	May 3.....	112.08	65.14
" 28.....	100.00	57.87	" 10.....	105.50	62.39
" 29.....	99.62	57.75	" 17.....	101.21	58.50
" 30 Sunday.....			" 24.....	100.12	58.52
" 31 Holiday.....			" 31.....	101.17	58.87

Monthly averages		1918		1919		1920	
Jan.	1918	1919	1920	July	1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.82	106.38	100.00
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	100.00
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	100.00
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	100.00
May	99.50	107.23	102.69	Nov.	101.12	127.57	100.00
June	99.50	110.50	102.69	Dec.	101.12	131.92	100.00

COPPER

Prices of electrolytic in New York, in cents per pound.

New York		Average week ending	
Date	cents	Date	cents
May 25.....	19.00	Apr. 19.....	19.25
" 26.....	19.00	" 26.....	19.21
" 27.....	19.00	May 3.....	19.25
" 28.....	19.00	" 10.....	19.12
" 29.....	19.00	" 17.....	19.00
" 30 Sunday.....		" 24.....	19.00
" 31 Holiday.....		" 31.....	19.00

Monthly averages		1918		1919		1920	
Jan.	1918	1919	1920	July	1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	20.82
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	20.82
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	20.82
Apr.	23.50	15.23	19.23	Oct.	26.00	21.68	20.82
May	23.50	15.91	19.05	Nov.	26.00	20.45	20.82
June	23.50	17.53	19.05	Dec.	26.00	18.55	20.82

LEAD

Lead is quoted in cents per pound, New York delivery.

New York		Average week ending	
Date	cents	Date	cents
May 25.....	8.50	Apr. 19.....	8.71
" 26.....	8.50	" 26.....	8.77
" 27.....	8.50	May 3.....	8.75
" 28.....	8.50	" 10.....	8.62
" 29.....	8.50	" 17.....	8.50
" 30 Sunday.....		" 24.....	8.50
" 31 Holiday.....		" 31.....	8.50

Monthly averages		1918		1919		1920	
Jan.	1918	1919	1920	July	1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	5.53
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	5.53
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	5.53
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	5.53
May	6.88	5.04	8.55	Nov.	8.05	6.76	5.53
June	7.59	5.32	8.55	Dec.	6.90	7.12	5.53

TIN

Prices in New York, in cents per pound.

Monthly averages		1918		1919		1920	
Jan.	1918	1919	1920	July	1918	1919	1920
Jan.	85.13	71.50	62.74	July	83.00	70.11	70.11
Feb.	85.00	72.44	59.87	Aug.	81.33	62.20	70.11
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	70.11
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	70.11
May	100.01	72.50	54.99	Nov.	73.67	54.17	70.11
June	91.00	71.83	54.99	Dec.	71.52	54.94	70.11

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Average week ending		1918		1919		1920	
Date	cents	Apr. 18.....	Apr. 19.....	May 3.....	May 10.....	May 17.....	May 24.....
May 25.....	7.95	18.....	18.....	18.....	18.....	18.....	18.....
" 26.....	7.90	26.....	26.....	26.....	26.....	26.....	26.....
" 27.....	7.85	27.....	27.....	27.....	27.....	27.....	27.....
" 28.....	7.95	28.....	28.....	28.....	28.....	28.....	28.....
" 29.....	7.95	29.....	29.....	29.....	29.....	29.....	29.....
" 30 Sunday.....		30.....	30.....	30.....	30.....	30.....	30.....
" 31 Holiday.....		31.....	31.....	31.....	31.....	31.....	31.....

Monthly averages

1918		1919		1920		1918		1919		1920	
Jan.	7.78	7.44	9.58	July	8.72	7.78	7.78	.....	.....	.....	.....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	7.81	.....	.....	.....	.....
Mch.	7.87	6.53	8.93	Sept.	8.78	7.57	7.57	.....	.....	.....	.....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.82	.....	.....	.....	.....
May	7.92	6.43	8.07	Nov.	8.75	8.12	8.12	.....	.....	.....	.....
June	7.92	6.91	.....	Dec.	8.49	8.00	8.00	.....	.....	.....	.....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Average week ending		1918		1919		1920	
Date	dollars	May 18.....	May 19.....	May 25.....	May 31.....	June 1.....	June 1.....
May 25.....	85.00	18.....	18.....	18.....	18.....	18.....	18.....
" 26.....	85.00	26.....	26.....	26.....	26.....	26.....	26.....
" 27.....	85.00	27.....	27.....	27.....	27.....	27.....	27.....
" 28.....	85.00	28.....	28.....	28.....	28.....	28.....	28.....
" 29.....	85.00	29.....	29.....	29.....	29.....	29.....	29.....
" 30 Sunday.....		30.....	30.....	30.....	30.....	30.....	30.....
" 31 Holiday.....		31.....	31.....	31.....	31.....	31.....	31.....

Monthly averages

1918			1919			1920		
Jan.	128.08	103.75	89.00	July	120.00	100.00	100.00	
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	100.00	
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	100.00	
Apr.	115.00	73.12	100.00	Oct.	120.00	89.00	100.00	
May	110.00	84.80	87.00	Nov.	120.00	78.00	100.00	
June	112.00	84.40	87.00	Dec.	115.00	95.00	100.00	

THE BUSINESS CYCLE

In the June number of its publication, 'Commerce Monthly', the National Bank of Commerce of New York explains the 'business cycle' and shows its relations to industry and finance. It says:

"The normal business cycle, as it occurs in the absence of special disturbing factors like a great war, has been carefully worked out by a number of recent writers. The description may start at any place in the business cycle, and the analysis will work around again through the cycle to the starting point. It is convenient to start with the close of the period of depression.

"At the end of a period of depression we find the following situation: (1) prices are low; (2) there have been drastic reductions in costs; (3) the margins of profits are narrow; (4) bank reserves are high; (5) conservative policies obtain as to borrowing, capitalization, and loans; (6) stocks of goods on hand are moderate; (7) buying is cautious. In such a situation an expansion in the physical volume of production and sales takes place, often with prices still falling. During the period of depression which is coming to a close, people have used up their stocks of clothing and shoes, have reduced the volume of household furnishings, linen, china, and the like, factories have allowed equipment and stocks of raw materials to get as low as seems wise, and new buying is forced upon everyone who is in a position to undertake it. Moreover, a growing volume of conservative business men and investors who had 'sold out' on the crest of the preceding wave of prosperity have reached the conclusion that things have about reached bottom and are disposed to invest or to start business again. There comes then a slow and cautious revival and expansion in the physical volume of trade. Slow at first, this process is cumulative, and it gradually turns slow business into active business. The revival may start in a narrow field, but necessarily it spreads to other fields, because the active concerns will have more spending power, which leads them to increase their buying from other enterprises. The active concerns, moreover, employ more labor, which increases the spending power of laborers and increases the demand for many things. Increased retail demand leads to increased demand on jobbers and wholesalers, who pass it on to manufacturers, who take on more laborers, who increase their retail buying. The quickening of industries reacts on the starting point, which in turn gives renewed impetus to other fields.

"There comes, moreover, a psychological change. The 'temper of business' is not a thing which is made by men as separate individuals. Rather, it is a social product. The man who finds business in his own line expanding becomes an optimist with regard to business at large. He talks with other men. They, even though they have not felt increased orders for their own goods, begin to be influenced by his optimism. The process is partly rational and partly non-rational. The mere fact that men find their neighbors more cheerful influences them unconsciously even in the face of facts. On the other hand, the man who has been delaying an increase in his own business activity may well find a valid ground for taking positive action if he finds increasing confidence among those about him. The temper of business, an intangible and psychological thing, is, none the less, one of the most fundamental realities with which business men must reckon.

MONEY AND EXCHANGE

Foreign quotations on June 1 are as follows:

Sterling, dollars:	Cable	3.92
	Demand	3.93
Francs, cents:	Cable	7.79
	Demand	7.80
Lire, cents:	Demand	5.97
Marks, cents:		2.73

Eastern Metal Market

New York, May 26.

Business is exceedingly light in all the markets and prices are mostly lower. The railroad situation is responsible for the former and the decline in the London markets is a large factor in certain metals.

Copper demand is light but prices are firm.

Buying of tin for future shipment has declined decidedly and prices are lower.

The lead market shows little change.

There is still no life to the zinc market and prices have again receded.

Antimony has also declined.

IRON AND STEEL

Improvement in freight movements has been slower than expected. Fuel continues at the moment to be the first consideration of both mill and consumer, and naturally every effort is being made to move raw and manufactured materials, says 'The Iron Age'.

Of the leading producing centres greatest relief from the traffic congestion appears in the Pittsburgh district. The scattering of railroad workers to lucrative employment, in some cases with municipalities, is checking rapid resumption of the railroads and the now heavy use of the motor-truck for relatively short hauls promises to remain more general in the future.

Uncertain deliveries have chilled buying and the few cancellations reported are not indicative of any cessation in demand. Steel plates and structural material are easier. Prices in general are not only well sustained, but several advances have been made. Consumers are bidding against each other for coke and fully \$2 more per ton has been obtained for both the furnace and foundry product.

COPPER

The most interesting piece of news in this market is the fact that refinery operations have dwindled to considerably less than 50% of capacity as a direct result of the transportation situation. In some cases certain plants have had to shut down and then been able to operate again for a short period. Buying is only moderate from domestic consumers but foreign demand is still good. There is no incentive to buy when shipments are so uncertain, particularly from the East where railroad congestion is perhaps the worst and where most of the copper is refined. Of the refined output for the first five months of the year it is stated that about 43% went abroad or 265,000,000 lb., of which Japan took at least one-fourth. Leading producers continue to quote electrolytic copper at 19c. for early delivery, with 19.25 to 19.50c. asked for July-August shipment. In the outside market there are isolated transactions as low as 18.12½ to 18.25c. by dealers or speculators.

TIN

There has been a decided cessation in the buying of future-shipment Straits tin which has characterized the past three weeks. In the week up to Monday about 350 tons was sold but the demand has about ceased. Consumers seem to be afraid to enter the market, due largely to a further slump in London, and they are waiting to see whether the market has touched bottom over there. On Thursday and Friday last week one seller sold a fair amount but there is no extended demand. Banca tin was sold on Friday last at 48.87½c. for 30-day shipment from London. In the past week future-shipment Straits has sold from 51 to 53.75c., depending on the position, and 99% tin has sold for 49 to 49.75c. for August delivery. Monday of this week was a holiday in London and consequently the market here was stagnant. Spot Straits tin in New York has hovered around

53c. the past week, but yesterday fell to 51c., due to a decline of £6 per ton in the London price, which yesterday was £289 per ton. A week ago it was £302 per ton. Arrivals thus far this month have been 6180 tons with the quantity afloat reported as 1340 tons. An interesting item is the reported arrival of 3880 tons of tin ore thus far this month.

LEAD

The only interesting factor in this market is the scarcity of spot and prompt-shipment lead in the New York market. As high as 9.37½c. has been paid for spot and 8.75c. for prompt shipment from the West. For later nearby deliveries 8.50c., New York, has been realized. The market is quiet but steady. We quote the outside market at 8.15c., St. Louis, and 8.50c., New York, with that of the leading interest unchanged at 8.25c., St. Louis, and 8.50c., New York.

ZINC

The market could not be more lifeless. There is almost an entire absence of interest on the part of both consumers and sellers. Only hand-to-mouth demand is being satisfied and it is difficult to get transportation. Prices have gradually declined in the week, due in part to lower values in London, but a stiffening in pounds sterling has been a steadying factor. Prime Western for delivery before August is quoted, more or less nominal, at 7.60c., St. Louis, or 7.95c., New York. Exports for March were 28,058,238 lb. against 16,159,469 lb. in March 1919. Of the March exports this year Great Britain took 18,706,833 lb., France, 6,309,990 lb., and Japan, 842,382 pounds.

ANTIMONY

The market is quiet and lower. The better grades are quoted at 9.25 to 9.50c., New York, duty paid, in wholesale lots while for other grades 9c. is asked and has been paid.

ALUMINUM

The leading producer is asking 33c. for virgin metal, 98 to 99% pure, for wholesale lots, for early delivery, with 31.50c. asked by other interests.

ORES

Tungsten: The market is still dull and featureless. Low-grade ores are quoted around \$6.75 per unit in regular concentrate. There is little prospect of any final action on the tungsten bill and until this is settled business will remain dormant.

Ferro-tungsten is quiet and unchanged at the nominal prices of 85c. to \$1.15 per lb. of tungsten in the alloy or the powder.

Molybdenum: Action in this market has been absent and prices are nominally unchanged at around 75c. per unit in regular concentrate.

Manganese: Prices for high-grade ore are unchanged at 65 to 83c. per unit, seaboard, depending on the delivery, but no new business is reported. Of the 18,970 tons imported in March, 12,200 tons came from Brazil and 1000 tons from India. Of the 151,898 tons imported for the nine months ended March 31, 1920, Brazil sent 97,396 tons; India, 12,200 tons; Cuba, 3136 tons; and Japan, 447 tons; with 38,719 tons credited to other countries.

Manganese-Iron Alloys: Still another electric plant will make ferro-manganese. A company in Alabama, which made considerable during the War, will soon start to produce again. Prices are unchanged at \$225 to \$250 for delivery before July 1, with \$200, delivered, asked for last half. While just now quiet, due to the falling off in the steel output, the market is strong. Demand for spiegeleisen, particularly from foreign sources, is good with \$75, furnace, the minimum price.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

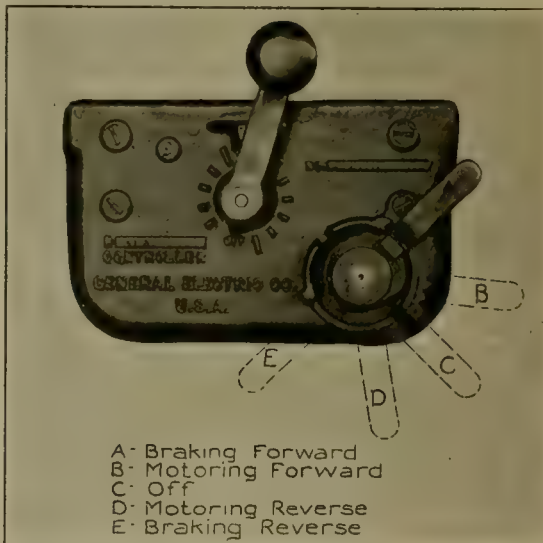
AN IMPROVED MINE-LOCOMOTIVE

The General Electric Co. has recently developed a new mine-locomotive, which incorporates several interesting improvements over the types formerly in use. In mine work there is a considerable amount of braking to be done, owing to the numerous stops that must be made for throwing switches and coupling individual cars. The consequence is that, with the hand-brake, considerable physical effort is used by the motormen, who, if he is careless, develops the habit of stopping the locomotive by reversing the motors, thereby damaging the wheels, the motors, and the gears.

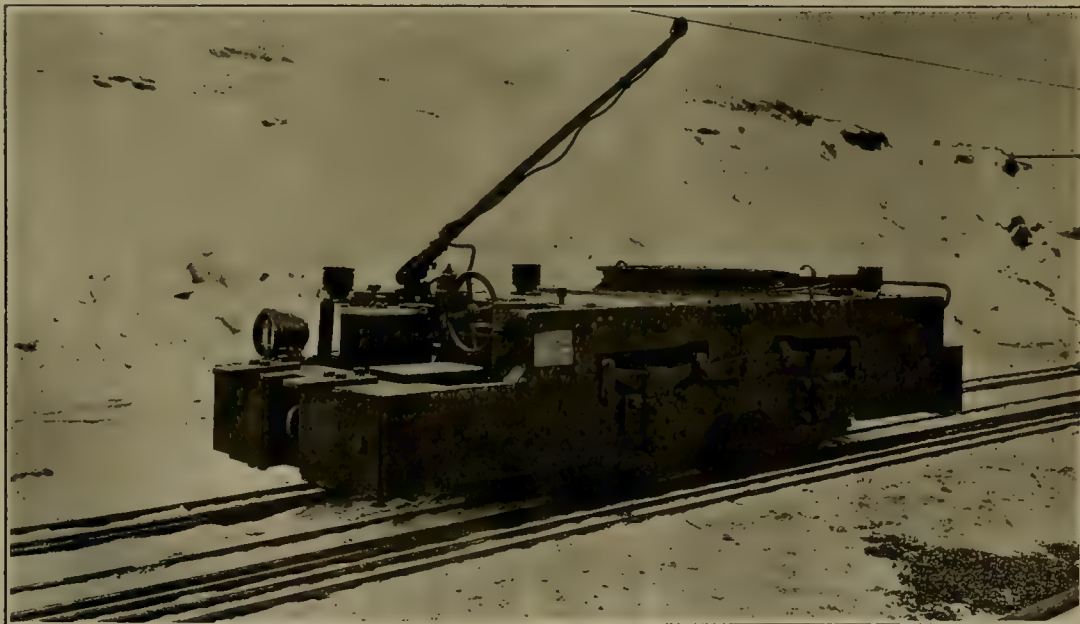
The 'braking' on the new locomotive has been made electrical to avoid this trouble. The controller is designed so that when the reverse cylinder is set at the braking position, the motors are turned into self-excited generators, the energy being absorbed in the main resistors. On a level track the motorman can bring his train to a dead stop without using the hand-brake at all, but on a grade, since there is no energy developed when the wheels have stopped turning, it is necessary to set the hand brake to hold the train. The controller is provided with a three-position indicator, 'forward', 'reverse', and 'braking' are all obtained by moving the handle in one direction. Another feature of the controller is that the points are so arranged that the motorman cannot get to parallel until he has been through series, hence he cannot get slow speed by leaving the reverse cylinder in the parallel position and running on the resistance point. This, of course, has a bad effect on the resistors, and

uses much more current than if the motors were in series.

The other features of the locomotive is its spring construction. Instead of the ordinary coil-spring, this loco-



Top View of Controller



Improved Mine-Locomotive

motive is equipped with leaf-springs of the semi-elliptic type. The springs are hung at one end of the frame, the other being connected by an equalizer bar between the two on each side. The result of the use of this bar is that, if one wheel encounters an obstruction or goes into a hole, the change in load is transmitted to the other wheels. This not only gives the locomotive better riding qualities, but decreases the tendency to de-railment. When it is de-railed, owing to the high clearance between the rail-head and the lower edge of the side frame, which is a feature of its construction, it is a comparatively simple matter to get access to the lower part of the wheel so that blocking or other de-railing devices may be put into position.

BOOKS AS TOOLS

By E. A. Goeway

The American employer, still striving to overcome the many unusual business and financial conditions which have followed in the wake of the War, is becoming more and more convinced that among the most serious features of his problems are a pronounced shortage of labor and a dearth of workers skilful to the point of high proficiency. The quantity demands of the war period no longer are maintained in many industries, and the American employer soon must face a sharp foreign competition. However, he is not losing sight of the fact that, in the long run, quality rather than quantity will stabilize 'Made in America' goods in the markets of the world. But, to do this, the domestic manufacturer must obtain employees who are thoroughly capable, that the products of the United States may equal in every way the best produced abroad. How can he obtain this much desired efficiency on the part of his employees? To this query there are many answers, but there is no question that one solution of this difficulty points straight to the magic gateway to erudition—books. Already, in line with this thought, many far-seeing manufacturers and heads of business institutions have installed in their plants special libraries of technical books for the use of their workers, as well as for reference by themselves. From such libraries the worker may obtain books giving the most minute information upon the industry in which he is employed, and such books are in demand both during the lunch hour and for quiet reading at home. This plan is not a tentative scheme, but an established fact, and in such places as it has been followed it has met with the greatest favor on the part of both the employer and the worker. Among the great commercial and business institutions which have found that the installation of a special library of technical books was a wise step, might be mentioned: Marshall Field & Co., B. F. Goodrich Co., American Telephone & Telegraph Co., Studebaker Corporation, National City Bank, Winchester Repeating Arms Co., Guaranty Trust Co., National Cash Register Co., General Electric Co., Sears, Roebuck Co., and the Curtis Publishing Co.

But there still is a deplorable lack of good libraries in business houses, shops, mills, and manufacturies when the country is considered as a whole. Every employer should be brought to see the benefits to be derived from these special libraries, and an important step toward this end has been taken by the American Library Association with its peace-time enlarged program, which is being carried out with the significant slogan, 'Books for Everybody'. The enlarged program contemplates doing many things toward an even more general extension of the library service, emphasizing four outstanding features. One of these, and a very important one indeed, is with the aid of the Special Libraries Association to encourage a larger use of the technical books now in the public libraries and to urge employers of labor in factories and plants to install special libraries of technical books for the use of their employees. To assist American-

ization publishers will be asked to print standard American works, in the various foreign tongues, so that the immigrant upon arriving in this country can have this literature placed in his hands and in the language which he will understand most easily.

COMMERCIAL PARAGRAPHS

Announcement is made of the removal of the offices of the Power Plant Corporation and the Trent Process Corporation from the McGill Bdg. to 1440 Yon street N.W., Washington, D. C.

George E. Long has retired as senior vice-president of the Joseph Dixon Crucible Co. Mr. Long is 70 years old and has been in the service of the company for 43 years, during which time he has advanced from his original position as stenographer. He was largely responsible for the development of silica-graphite paint for protective purposes and for the use of graphite as a lubricant.

The Wellman-Seaver-Morgan Co., of Cleveland, has issued a series of bulletins showing some of the construction work of the company. The numbers and subjects follow: No. 41, coal and ore-handling machinery; No. 42, special cranes; No. 43, hydraulic turbines; No. 44, hoisting and mining machinery; No. 45, steel-works equipment; and No. 46, coke-oven machinery.

The Fairbanks Co., with administrative offices in New York and branch houses in all large cities, has recently issued a 256-page catalogue illustrating and describing its complete line of power-transmission appliances and elevating and conveying machinery. In addition, the catalogue contains full data as to dimensions, capacities, etc., making it a useful handbook for the man who designs or installs mechanical equipment of this nature. The book, which is attractively bound in dark green cloth, will be sent on request to executives, engineers, master mechanics, millwrights, and those concerned in procuring material described.

The sixtieth anniversary of the 'Mining and Scientific Press' emphasized the fact that for fifty-four years the business conducted by Braun-Knecht-Heimann Co. has been closely identified with the mining field, particularly the work of metallurgists and assayers. Scarcely an important mine or mill in the West but that has at some time been a customer of this firm, and most of them still are. An international reputation is enjoyed by the line of Braun laboratory machinery sold by the company and its Los Angeles affiliation, the Braun Corporation. Crushers, pulverizers, flotation machinery, cyanide supplies, cupels, glass-ware, and the scores of other supplies needed by metallurgists and assayers are carried in stock.

The Schaffer Engineering & Equipment Co., to provide for the expansion of its business and to obtain more ample plant facilities, has sold a large block of its capital stock to the Fawcus Machine Co. The Schaffer company's various lines of machinery, including poidometers, hydrators, coal injectors, and screens are well known. The rapid growth of its business necessitated better manufacturing facilities. The Fawcus Machine Co., manufacturers of gears and special types of machinery, with large plants at Pittsburgh and Ford City, Pennsylvania, will build the machinery required, and the inventive genius of J. C. Schaffer and the thorough understanding of its customers' needs of Waller Crow will be backed by the active interest which the officials of the Fawcus company will take in the Schaffer company. The officers of the Fawcus company, who will take active interest in the Schaffer organization, are A. F. Cooke who has valuable ideas in machine-shop practice; Elliot A. Kebler, prominent in financial circles and identified with iron-manufacturing companies for many years; and A. A. Alles, Jr., who has done much toward unifying and stabilizing costs in manufacturing.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 120 Market St., San Francisco,
by the Devery Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BGS., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BGS., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JUNE 12, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

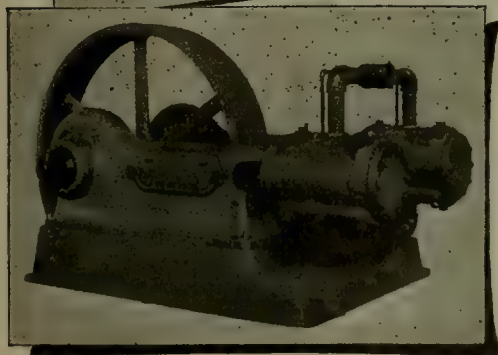
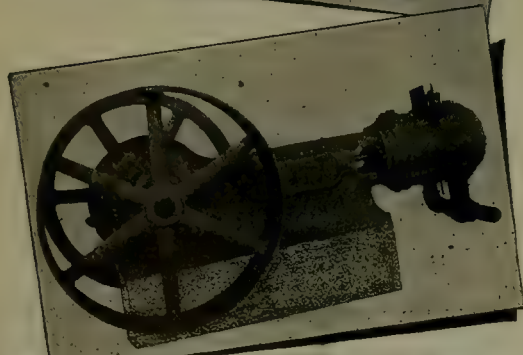
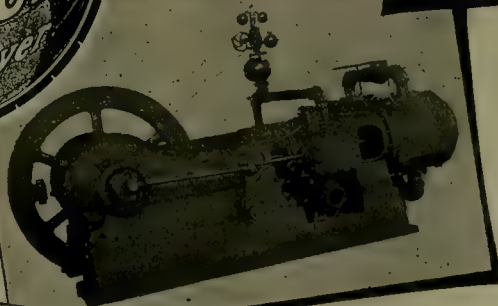
	Page
EDITORIAL	
NOTES	853
E. GYBBON SPILSBURY	854
AMERICAN MINING ENGINEERS ABROAD.....	854
Statement issued at Washington denying discrimination against American managers in the British dominions. Mr. Hoover and his Burma shares. Return of American mining engineers from London and the reasons for it. Friendly relations between British and American members of the profession, Hearst and Bottomley to the contrary.	
PROSPECTS IN MEXICO	855
The attraction of Mexico. Report of the Senate committee headed by Senator Fall. Outline of the results of this investigation. Frankness of the report. Status of Americans in Mexico. Insistence upon fair treatment. Promise of financial aid to Mexico if our citizens are treated properly and order is restored in the country. The plague of generals. Obregon's opportunity.	
DISCUSSION	
THE CASE OIL-FIRED ASSAY-FURNACE	
By P. L. Guppy.....	857
The opinions of a successful user of the furnace.	
INDICATORS	
By Edgar Hall	857
The 'gouge' in the Bunker Hill mine and an analogous formation in Australia.	
TECHNICAL WRITING	
By P. B. McDonald.....	857
Improving the English of mature engineers.	
ARTICLES	
THE THEORY OF THE CENTRIFUGAL FAN	
By Walter S. Weeks.....	858
Centrifugal pressure. Centrifugal force and velocity head; the action of the fan. Characteristic curves. Electrical analogy. Laws of fans. The exhaust fan.	
RECENT METALLURGY AT TRAIL, BRITISH COLUMBIA	
By F. H. Mason.....	863
The electrolytic zinc department. Ores from the Sullivan mine. Experimentation since 1912. Method of concentration. Details of the electrolysis. Production.	
A VOLUMETRIC METHOD FOR DETERMINATION OF TUNGSTEN	
By George M. Enos.....	869
Gravimetric methods are slow. Zinc as the reducing agent. Outline of procedure. Notes.	
THE FAHRENWALD FLOTATION MACHINE	
By Francis A. Thomson.....	871
The power required by most machines. The advantages of the Fahrenwald device. Details of operation. Laboratory and commercial-size machines.	
NOTES	
SMELTING OF CYANIDE PRECIPITATE.....	870
THE COKE INDUSTRY DURING 1919.....	873
PRODUCTION OF MANGANESE	874
DEPARTMENTS	
REVIEW OF MINING	875
THE MINING SUMMARY	881
PERSONAL	882
OBITUARY	882
THE METAL MARKET	883
EASTERN METAL MARKET	884
COMPANY REPORTS	885
BOOK REVIEWS	886
RECENT PUBLICATIONS	886
INDUSTRIAL PROGRESS	887

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bdg.; New York, 3514 Woolworth Bdg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.

GARDNER

PUMPS AND COMPRESSORS



MINE pumps and compressors made by the Gardner Governor Company need no introduction to mining men, their high mechanical efficiency, wear resistance and ability to give steady service under difficult conditions make them particularly satisfactory in the mining field for both underground and surface work.

Gardner pumps and compressors are made by a firm of 60 years standing, their many special features, and improvements in materials and design are a result of long experience.

We are agents for the Gardner Line in the Denver, Salt Lake City and El Paso territory—and we can make prompt delivery of a Gardner mine pump or compressor—from the largest to the smallest. Write for details, the services of our engineers are at your disposal.

The Mine and Smelter Supply Company

A Service Station within reach of you

DENVER	SALT LAKE CITY	EL PASO
COLO.	UTAH	TEXAS

New York Office: 42 Broadway



T. A. RICKARD, Editor

DENVER has been selected for the next meeting of the American Mining Congress. The convention will be held during the week of November 15.

PROSECUTION of paper manufacturers under the Sherman and Clayton acts has been recommended by a Senate committee that has been making an investigation into the high prices now being charged. Profiteering in paper is only one of the many consequences of the industrial disorganization due to the War, under cover of which the prices of most commodities have been raised shamelessly in order to enable manufacturers to make preposterous profits. The committee of the Senate to which reference is made has devoted its attention chiefly to news-print paper, which has risen from two cents to ten cents per pound, but a similar condition obtains in the market for book-paper, such as is used by magazines and other periodicals, the publishers of which have to pay as much as 20 cents for paper that cost 4 cents four or five years ago. Whether the increase is legitimate or not is answered by the fact that the manufacturers are making money hand over fist, and obviously are in collusion.

THE sailing of the steamship 'Victoria' on June 4 from Seattle for the Seward peninsula and Nome recalls the occasion, exactly 20 years ago, when the rush started that made a tented city of 30,000 assorted miners and adventurers, crooks and tenderfeet on the shore of Bering Sea during the summer of 1900. The underwriters will not permit an insured vessel to enter the ice-infested waters until after June 8, so that each year the first boat starts for the north early in that month. The last ship 'out' leaves Nome in October; during the long winter the only communication is overland by dog-team over hundreds of miles of desolate snow and ice, by way of Fairbanks. The 'Victoria' has been making the journey regularly since 1908, but this year scarcely a quarter of her cargo is destined for the town made famous by its gold-laden beach-sand from which \$5,000,000 was won with no more elaborate machinery than the 'rocker' and the 'long-tom'. Those who came out on the last boat in October 1899 carried with them enough 'dust' to substantiate their reports of the richness of the deposits on Anvil, Dexter, Dry, and other creeks, and on the beach itself. The news spread so that twenty years ago many an old hulk was rehabilitated to take the

thousands of gold-seekers, who thronged the wharves of Seattle and San Francisco, intent upon being the first to reach the new diggings and an easy fortune. Many became rich; more suffered bitter disillusion. Now Nome is an orderly town on the frontier; it is a meeting place for the civilization of the peoples of the temperate zone and the simple barbarism of the natives within the Arctic circle.

DURING the past week the representatives of the national engineering organizations have been in conference at New York under the leadership of Engineering Council. If the American Association of Engineers can abate some of its claims, it is probable that a real union of engineering societies, for the general benefit of the profession, may be effected. Incidentally, we note with pleasure that the 'A. A. E.', as it is called for short, on the occasion of its recent convention at St. Louis, endorsed the following statement issued by the directors of that organization: "We believe in organized representation for the correction of wrong, the advancement of the engineering profession and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence in engineers. The American Association of Engineers, recognizing the many fundamental differences between the principles of the trade-union and an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both." The resolution recommended the expulsion from the Association of engineers who advocate strikes or similar methods of securing their ends. This is a move in the right direction, if it mean that engineers as a body will use their best effort to reconcile disagreements by conciliation, arbitration, and fair adjustment.

OIL THIEVES is the title of an article issued by the petroleum section of the U. S. Bureau of Mines. One might suppose that it discussed the theft of oil, but instead it describes the manner of taking samples of oil at intervals beneath the surface of the liquid in a tank. The writer calls it a "fluid", which is not precise, because 'fluids' include gases as well as liquids. However, that is by the way. The instrument used for the purpose of this sampling is called an 'oil-thief' and the method is known as 'thieving'. Consequently the article is full of such phrases as these: "Thieves of all types

have their good points", "The purpose of thieving oil is to obtain, etc.", "The thief has an apparently insignificant part in the handling of oil". We submit that the use of a common word in a technical sense is objectionable, because it causes a repeated derailment of thought and a confusion of ideas entirely prejudicial to the purpose of the writing, which is to convey information to the reader as effectively as possible, and, we may add, as pleasantly as a technical subject will permit. We shall be told, of course, that 'oil-thief' is a well-established term in the oil industry and that we are running our head against a brick wall of custom. That may be. We refer to it now merely as an example of the manner in which technicians allow Tom, Dick, and Harry to supply them with terms that ought to be significant and precise, but are nothing of the kind. Another example is 'vegetable'. People talk about 'vegetable oil', and 'vegetable kingdom', thereby awakening the idea of cabbages and peas, just as if the adjective 'vegetal' did not exist. We might as well talk of the 'beast kingdom' instead of the 'animal kingdom'. In these matters technical men are too lazy; indeed, they are unscientific because they use an instrument of precision, their language, carelessly.

SUNDRY interesting conclusions regarding the nature of the damage done to farms by smoke from lead and copper smelters appear in the recent findings of Judge Johnson, of the U. S. District Court at Salt Lake City. Twenty years ago it was realized that crops suffered to some extent from the effects of smoke. The result was a series of lawsuits, some of which were tried and many of which were merely threatened and settled out of court. Some of the farmers derived more profit from their 'blighted' crops than they might have done from their harvests alone, had the smelters not become a source of revenue to them. The idea then developed that the fume was a menace to the health of cows, pigs, and horses; and even the corrosion of barbed-wire fences was attributed in some instances to the smelter-smoke. In order to determine just how much harm the smoke really did, and to ascertain just what constituents were injurious, the United States Smelting company at Midvale and the American Smelting & Refining Company near its Murray plant started experimental farms in charge of trained investigators, who undertook to solve these problems in a scientific way. The introduction of bag-houses, and later of electrical precipitation devices, followed, and so successfully have they been developed that practically all the solid particles in the smelter-smoke can now be removed before it leaves the stack; so that whatever damage is done must be accounted solely to the gaseous constituents. In the opinion handed down by Judge Johnson, in the case in which the two companies are co-defendants, the findings are based largely on definite proof resulting from the experiments conducted on the company farms. He finds that there is no "invisible injury" to vegetal tissue, but that plants must be bleached or burned perceptibly, presumably by sul-

phuric acid produced from sulphur di-oxide gas, before they are harmed; that there is no injury to screen or wire fences resulting from the operation of these smelters; that there is no injury whatever to animal life; and that as regards the health of human beings, the only possible harm is that which may arise from mental disorders induced by imaginary worry. It would seem that so-called Christian Science ought to be an effective preventive for the last trouble. The only possible ground for just complaint appears to be damage to plants; this can be minimized by sufficiently diluting the sulphur di-oxide with air, and the obvious way to accomplish this is to build high stacks; if the gases are discharged into the atmosphere at a point far enough above the ground, diffusion and dissipation by air currents will render them so dilute as to be innocuous by the time they reach the earth. The outcome of the suit is a victory for scientific research. The farmers themselves, if they want to be reasonable, can have the facts proved to them by actual demonstration.

E. Gybbon Spilsbury

On another page we publish a formal obituary of E. Gybbon Spilsbury, and we regret deeply the occasion for it. He lived to a good old age and enjoyed a career unusually rich in variety of experience; he was successful in his profession and he was elected to positions of honor; but he achieved much more than that: he made friends and held them. Among the men of the passing generation, none showed a wider or more generous sympathy with those about him, or a more instant willingness to be helpful to those less fortunate than himself. Above all, he had the lovely trait of being interested in other people and in doings outside his personal participation; he kept himself young in spirit, long after he was old in body, by this keen interest in all that was happening in the world about him. Many men now seniors themselves will remember how kind he was to them when they were callow youths and will join with us in this tribute to his memory. He leaves three worthy sons; to them the name of their father should be a stimulus to good work and right thinking until they in turn transmit the Spilsbury tradition to their sons.

American Mining Engineers Abroad

Various statements have appeared in the Hearst papers charging the British government with orders in council and other regulations prejudicial to the management of enterprises in the British dominions by Americans. On June 5 it was announced at Washington: "Authoritative information has revealed that the recent order in council requiring firms under British registry in China to be managed entirely by British subjects was aimed at certain companies which have abused the privilege for purposes such as smuggling opium. It is declared that the order was not directed against foreign interests as such, and least of all against American interests." It

has been stated that American mining engineers have found it difficult to remain as managers of British-owned mines in foreign countries and even that Mr. Hoover was compelled to sell his shares in the Burma Mines, Ltd., on account of his nationality. This last statement we know to be without foundation. As to the larger assertion, of unfriendly discrimination against American engineers, we have taken pains to write to American and British mining engineers in London for precise information, and we are glad to say that the rumors are said to be untrue. During the War, of course, there were suspicions and inquiries directed against Germans and Austrians who under cover of American citizenship were acting as agents for the enemy countries, and our own experience of the misuse of naturalization in this country will suffice to indicate how necessary the British may have found it to be particular in regard to the freedom of action allowed to suspected persons. During recent years a number of American mining engineers formerly resident in England have returned home, but this is due to causes fairly obvious, among which we may mention the diminution in British mining enterprise, due to the restrictions imposed by the British Treasury on the raising of fresh capital, the practical cessation of mining operations in Siberia, the high income and excess-profit taxes, and the call that the United States made to its own citizens as soon as it entered the War. Since the Armistice there has been a plague of recrimination and jealousy between the peoples that were allied against the common enemy, and sundry newspapers on both sides of the Atlantic have given vent to their spleen, playing into the hands of the pro-German and Sinn Fein factions, and of the more numerous persons disgusted by high prices and the shameless profiteering that have killed the generous emotions evoked by the stress of conflict. Moreover, in Europe, there is a feeling, which, to be candid, we must recognize, that the United States has not lived up to the fine humanitarian spirit expressed in the days of extreme crisis and that the withdrawal from the League of Nations is an action not in accord with the confident expectations engendered by American participation in bringing the War to an end. That is a subject for controversy, unfortunately, and we mention it only to make the record complete and to explain the disappointment that prevails in London and Paris. It has not had any direct effect upon the pleasant relations subsisting between the English-speaking members of the mining profession, and we hope that even its indirect effects will pass in due time, when our domestic political issues have been settled by the election of a new President and a Congress instructed to act for the Nation in the further readjustment of the world's affairs. We, of course, are jealous in behalf of our profession, wherever it may be called upon to exercise its talent in the exploitation of mines and the management of mining enterprises abroad; we would regret, and resent, any discrimination against the American mining engineer whether in Mexico or South Africa, but we have surer reason to resent the

campaign of misrepresentation conducted by the gutter press, such as Hearst's in San Francisco or Bottomley's in London. If any American mining engineer has cause to complain of unfair treatment under any foreign flag, we invite him to state his case in our columns, and we promise to draw the attention of the proper authorities to the matter, so that it may be investigated in due course. Many of our American mining engineers are members of the Institution of Mining and Metallurgy in London; the council of that engineering society has never failed to show goodwill to Americans as such; indeed it elected an American as its president twice; we feel sure, although having no authority whatever to say so, that the Institution would second any efforts made from this side to prevent discrimination against any properly qualified American engineer in the exercise of his professional duties or the advancement of his career under the British flag, just as surely as the American Institute of Mining and Metallurgical Engineers would endeavor to prevent any similar unfairness to a British engineer performing his proper function under the American flag. Let Hearst and Bottomley rage; the solidarity of our profession, within the bounds of genuine patriotism, will not be endangered so long as we are frank to one another and true to the tradition of our calling, which is to convert the resources of Nature to the use and benefit of mankind by the application of technical science and organized industry.

Prospects in Mexico

The public interested in mining is watching with close attention the course of events in Mexico. To a large group of mining men the country south of the Rio Grande is the most attractive mineral region in the world; to them the call of Mexico is as insistent as that of Alaska to the 'sourdough' or of the Transvaal to the Afrikaner. We sympathize with that attraction toward the land of the Aztecs, for Mexico unquestionably is a mining region of remarkable character and unrealized wealth. When will it be re-opened to peaceful industry, more particularly the working of mines by American operators? First we shall glance at the report of the sub-committee selected by the Foreign Relations Committee of the Senate. This report was issued on May 31 and is the joint product of Senators Albert S. Fall, Marcus A. Smith, and Frank B. Brandegee, representing the States of New Mexico, Arizona, and Connecticut respectively. The report embodies the results of a thorough investigation; it is likewise thorough in its recommendations, which, briefly, are that recognition of any new Mexican government be withheld until it shows evident marks of stability and "the disposition to comply with the rules of international comity". Recognition is to be contingent further upon the assurance of protection to American citizens and the payment of indemnities for damages done to them in Mexico. As a matter of record it is stated that 461 Americans have been killed in Mexico and 126 more at the border, during the recent years of

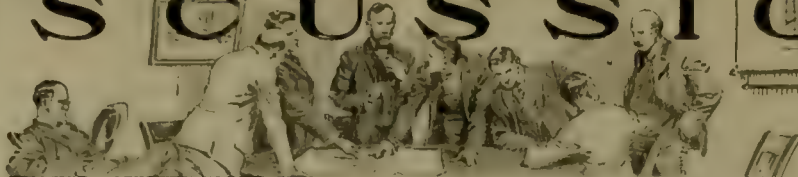
misrule. Claims for damages amount in all to \$505,002,-434. Restrictions and prohibitions against the ownership of property or the doing of lawful business by Americans in Mexico are not to be endured and must be cancelled. If the Mexican government should continue to discriminate against our citizens or subject them to further indignities, it would be the policy of the United States not only to refuse recognition to the Mexican government but to send a police force to impose order and to keep open the lines of communication between the city of Mexico and every seaport of the country. If, on the contrary, the Mexican government should prove friendly and should manifest its ability to restore order, then it is to be the policy of the United States to accord to Mexico not only its "moral support, but financial aid without stint in so far as same is necessary for the refunding of all Mexican bonds, including the external as well as the internal debt, with additional funds in sufficient amounts to rehabilitate all the Mexican railroads and to maintain same, and also sufficient amounts to enable the recognized government to re-establish, organize, and thoroughly equip a purely national army not belonging to any particular chief, chieftain, or general, but operating under the national government, which shall immediately proceed to disarm all other armed forces or individuals in the republic". The report closes by asserting it to be the national purpose to protect our citizens in Mexico, so that they can go about their business in safety. It is high time that this pronunciamiento were made; we hope that the report will lead to administrative action and that the fundamental idea of safeguarding our nationals in their peaceful and lawful occupations anywhere will be endorsed by the Congress and the President. To the mining profession such a declaration of policy would be of vital importance, for without it the American engineer is grievously handicapped in Mexico and elsewhere, as compared with the nationals of other countries whose governments show themselves more solicitous in this regard.

Senator Fall's report can hardly be called diplomatic; parts of it are couched in terms that might be deemed offensive to our friends in Mexico, as for example, the direct threat to send a police force to open and maintain the principal lines of communication, but we anticipate that the Secretary of State, should he act upon the report, will soften the language so as not to hurt what the President has called "the proud punctilio" of the señores below the Rio Grande. Certainly it is time to speak frankly to our southern neighbor if we are to understand each other. No reason should exist for relations much less friendly with Mexico than with Canada; southward, as northward, the American mining man ought to be assured of the protection not only of his own government but also that of the country in which he is conducting his lawful business, to the mutual benefit of the individual and the country of his sojourn.

General De la Huerta, the President *ad interim*, and General Obregon, who appears most likely to be chosen as President in the forthcoming election, three months

hence, have expressed sentiments of good-will toward the United States and its people. The pro-German and pro-Japanese Carranza has gone the way of unpopular Mexican presidents; we are warranted in anticipating a more friendly policy from his successors. In order that there may not be too many of them in too short a time it is necessary that the plague of generals be lifted from Mexico, that the pseudo-militaristic regime be broken decisively, and that the civilian element be given control of the administration. A group of young men, posing as soldiers, but in reality only grafters, has dominated Mexican politics during recent years, and even during the days of Diaz. They have looted the treasury and victimized the people; and nobody knows it better than General Obregon. It is to his interest to stamp out the plague, which otherwise will menace his own position as President. Under Carranza's regime two-thirds of the Federal appropriations went to the Department of War and Marine, which means that they went to the Army. It was an army that was unable to prevent brigandage or even to quell sporadic revolution because it existed largely on paper; the 120 millions of pesos allotted to it went largely as loot to officials, chiefly a group of about fifty generals and their staffs, most of whom have been living riotously on their spoils. Even Diaz, when at the last his autocracy was menaced, found that the 100,000 soldiers for whom he had been paying were a fiction, and that he could put only 14,000 in the field. From the sum allotted to each commander of troops for rations to his men and for fodder to his horses, a major portion is withheld—that is, stolen—because the commander puts the horses to graze on private land and contents himself with a nominal fraction of the men supposed to be under his orders. Each general has a few retainers of whom he takes good care and on whom he can depend whenever he changes his support from one side to another, so that in the end the country is dominated by a group of bandits in Federal uniform. The military feature is subordinated to a vulgar graft that is hardly masked by the gaudy veil of politics. Meanwhile the schools and railways have been deprived of the funds necessary to maintain them, so that education and industry are starved. So are the people as a whole; for what inducement is there to grow corn or to breed cattle when both products may be seized without compunction by a 'general', claiming to represent Federal authority, but actually an irresponsible young thief in a gaudy uniform. General Obregon knows all this well enough and he realizes that unless he breaks the system that holds Mexico by the throat his own government will be imperilled at the start and his efforts to restore the country to peace and quiet will be defeated. There is much for him to do; he must retire the 'generals' and organize an effective police force after the style of the old *rurales* of Diaz. After that he will have to stamp out brigandage whether it be of the cut-throat type, like Villa, or a polite *revoltoso*, like Pelaez. We wish him luck, for we also have felt the charm of Mexico and of its people, and would like to go to Mexico again.

DISCUSSION



The Case Oil-Fired Assay-Furnace

The Editor:

Sir—The defects cited by F. Borzynski in his article in your issue of May 15 on the operation of the Case oil-fired assay-furnace would deter anyone from using it.

Being, at an earlier date of their usage, an operator of such a furnace, I can vouch for their high efficiency under any stress of importance, as well as in times of rush, and especially on good check-work on silver cupellation.

The effects of reducing gases or fume were never noted. Much depends on burner adjustment in order to secure an economical and perfect degree of combustion. For this the low-pressure air-flame cannot be rivaled, allowing, as it does, the flame to envelop itself around and over the top of the muffle, producing an all-round even temperature throughout the entire length of muffle.

One cause of trouble in preventing burner efficiency is due to the drying out of oil at the nozzle, which obstructs the passage of air, causing imperfect combustion. A daily rub-down of the burner with kerosene-oil will prevent this.

The furnaces adapted for use with hood-chimney I would recommend as requiring no damper adjustment whatever.

P. L. GUPPY.

McGill, Nevada, May 25.

Indicators

The Editor:

Sir—In the article (No. V) on 'The Bunker Hill Enterprise', appearing in your issue of February 21, page 262, occurs the following:

"Under this seam [the gouge] is a white, creamy, or buff band, ranging from a few inches to a foot or more in thickness, of crushed quartzite which is so finely powdered as to form what is usually termed sugar quartz. The white band contrasts strikingly with the black clay seam."

The peculiarity described resembles what miners have noticed in many other mines, and what they call an 'indicator'. The writer of the above description does not give any explanation of the formation of this peculiar seam of white material, nor have I seen any explanation of similar occurrences anywhere. Can any of your readers give an adequate explanation of these phenomena and how they came to be so?

In our mine here the orebodies are accompanied by such a seam, which is called by the men 'bleached

shale'. The country consists of tufaceous shale and slate, and is often quite black near the ore. The bleached shale could be described exactly by the words used in the above quotation, except that it is compact and not crushed into powder, and it is not quartz, but apparently of the same composition as the black shale. Where the lode and country are crushed and contorted, the bleached shale is also. This bleached shale is associated invariably with the ore, and is found extending beyond the ore accompanying the fissure and gouge, where there is no ore, but there is never ore without the bleached-shale seam. It is regarded by the miners as a sure sign that they are in an ore-channel.

I cannot form any theory about these peculiarities; my chemical knowledge is quite at sea on the subject. I notice the confident explanations so often given of exactly where the ore comes from (I have just read one, dismissed in a few convincing lines!), that I feel sure some of our younger men can tell us, what must be very simple, if we only knew.

EDGAR HALL.

Silverspur, Queensland, April 22.

Technical Writing

The Editor:

Sir—I was interested in A. T. Parsons' review of your new book, 'Technical Writing', in your issue of May 8, because I had just written a review of the same book for the 'Engineering News-Record' (issue of May 20). Mr. Parsons recommends that engineers should obtain a copy of the book and act upon its suggestions. Certainly the book is well suited for helping engineers to improve their English. However, I have noticed one curious consideration in teaching technical writing to engineers, both graduate and undergraduate: one type of engineer resents criticism of his English in much the same spirit that he resents criticism of his looks or his family. Even when a man of this type joins a class to learn English, he wants to be praised rather than be shown his defects. On the other hand, there is an increasing number of engineers that realize the need for devoting serious thought to improving their English. In some teaching that I have been doing at the Western Electric Company, where I had a class of engineers averaging 35 years old, I found research engineers and heads of departments keener about learning English than I ever expect undergraduates to be.

P. B. McDONALD.

New York University, May 21.

The Theory of the Centrifugal Fan

By WALTER S. WEEKS

***INTRODUCTION.** The performance of centrifugal fans is one of the most elusive subjects that confronts the mining engineer. It is my object in this article not to discuss the intricate design of fans, but to so explain their action that the operator may be able to visualize what goes on in the fan and so be able to predict or explain the results of particular applications.

Fig. 1 shows a section and front view of a simple fan. The air enters at the inlet on the side, and flows out radially through the blades until it strikes the fan-casing. It then follows the casing to the discharge.

A centrifugal fan is an air-pump. It takes air at one pressure and raises it to a higher pressure. Its use is to produce a difference in pressure between inlet and outlet. If we attach the inlet of the fan to the mine, the fan will take air at a static pressure below that of the atmosphere, because in order to make the air flow into the mine at the other opening, as it will in this case, the fan must establish an incomplete vacuum at its inlet. It will pump this air up to atmospheric pressure. Such a fan is called an exhaust-fan. If we attach the discharge of the fan to the mine, the fan will take air at atmospheric pressure and pump it up to a pressure above that of the atmosphere. Such a fan is called a pressure-fan. In this article I shall deal entirely with pressure-fans unless otherwise stated.

CENTRIFUGAL PRESSURE. Let us now see how the fan produces its pressure.

Suppose we whirl an apple around on a string with a as a centre. See Fig. 2. How much does the apple pull out on the string?

Let W = the weight of the apple.

r = the distance from a to the centre of the apple.

U = the linear velocity of the apple through the air in feet per second.

F = the pull in pounds on the string.

g = the acceleration due to gravity.

$$F = \frac{W U^2}{g r}$$

This pull F is called the centrifugal force.

*This is the second of a series of articles by Professor Weeks on the ventilation of mines. In the first article 'The Friction of Ventilating Currents', which appeared in the issue of April 24, two typographical errors occurred. On page 609 in the derivation of the formula the equation read

$$\frac{Q_1}{\sqrt{\frac{A_1^3}{K S_1}}} = \frac{Q_1 + Q_2}{\sqrt{\frac{A_1^3}{K S_1}} + \sqrt{\frac{A_2^3}{K S_2}}}$$

and the equation at the bottom of the same column should read.

$$K = \frac{p A}{S V^2}$$

Now let us suppose we have a pipe full of air as in Fig. 3. On the end of the pipe is a rod ab . The rod and pipe are whirled about a as a centre. The outside end of the pipe is closed. If we divide the air in the pipe into sections as shown, each section is like the apple. The force that it exerts on the one ahead of it may be calculated by the formula for centrifugal force. The farther away from the centre of rotation the section is, the harder it pushes. This is because the velocity increases as we go out from the centre. By calculus, we are able to obtain the sum of all the forces that the sections exert. We find that the pressure in pounds per square foot that the tube of air produces at the outside end is $w \frac{U_2^2 - U_1^2}{2g}$ where w is the weight per cubic foot of the air in the tube, U_2 is the linear velocity of the outside end of the pipe in feet per second, and U_1 is the linear velocity of the inside end. This calculation is based upon the assumption that all the air in the pipe is of the same density.

We may imagine the spaces between the blades to be made up of like tubes, so the centrifugal pressure produced by a fan is $\frac{w (U_2^2 - U_1^2)}{2g}$

where U_2 is the linear velocity of the tip of the blade and U_1 is the linear velocity of the heel of the blade.

The question may be brought up, is not the air at the outside end of the pipe more compressed than the air at the inside end, and hence of greater density? Therefore will the sections on the outside not press harder than the sections on the inside? The sections near the outside are heavier, but in ordinary practice the pressure that a mine-fan exerts is usually not over 5 in. of water, so the difference in pressure between the inlet and outlet is so little that the change in density may be neglected.

VELOCITY-HEAD. Besides the centrifugal force, we have another source of pressure, namely, the velocity-head in the air as it leaves the fan-blade. If we can slow down the air after it leaves the blade we can change this velocity-head into pressure-head. The gradual enlargement of the fan-housing in the form of a scroll is for the purpose of converting velocity-head into pressure-head. We should leave only enough velocity in the air to carry it away from the fan and into the mine at the desired speed.

This brings us to the question of velocity-head in the air. If a tank of water is h feet deep, and we punch a hole in the bottom of the tank, the water will flow out with a velocity of v ft. per second where $v = \sqrt{2gh}$, h being the head of water in feet.

Whence $h = \frac{v^2}{2g}$. $\frac{v^2}{2g}$ is called the velocity-head. It is the head in feet that will produce a velocity v . Now, if

the density of the liquid is w lb. per cubic foot, the pressure on the bottom of the tank is wh , or the pressure that can make the water flow out of an orifice with a velocity of v ft. per sec. is $\frac{wx^2}{2g}$ lb. per square foot.

In the case of the tank, we changed pressure-head into velocity-head. If we conduct the liquid with a velocity of v into an expanding cone so that the velocity is gradually decreased, the velocity-head will gradually change back into pressure-head.

It is useful to know what velocity of air in feet per minute has a velocity-head equivalent to one inch of water.

If we take 62.31 as a standard weight per cubic foot for water

$$\frac{wx^2}{2g} = H \ 62.31. \ H = \text{feet of water.}$$

$$\frac{wx^2}{2g} = \frac{i}{12} \times 62.31. \ i = \text{inches of water.}$$

If we take w as the weight of one cubic foot of dry air at 70°F. and at a pressure equivalent to 29.92 in. of mercury

$$v = \sqrt{\frac{2g \times i \times 62.31}{12 \times 0.07495}} = \text{velocity in feet per second.}$$

Give i the value 1 and multiply by 60.

$$V = 60 \sqrt{\frac{64.32 \times 1 \times 62.31}{12 \times 0.07495}} = \text{velocity in feet per minute.}$$

$$V = 4005 \text{ ft. per minute.}$$

This means that a current of air of this density flowing with a velocity of 4005 ft. per minute, if slowed down gradually to 0, would produce a pressure equivalent to that of one inch of water.

Velocity-head varies as the square of the velocity, so to determine the water gauge equivalent to x feet per minute we must multiply 1 by $\frac{x^2}{(4005)^2}$

For ordinary calculations the round number 4000 may be used.

To return to the fan: $a\ b$ (Fig. 4) represents a straight blade rotating about O . Air flows from the centre of the fan to the outside. If we stood on a fan-blade the air would pass us with a relative velocity of V . The tip of the blade is moving with a velocity U , so when the air leaves the blade it is moving with an absolute velocity of v ft. per second. As we let more air enter the fan, V increases, so v also increases, but its direction changes.

The velocity-head in the air as it leaves the blade is $\frac{v^2}{2g}$. If we can slow this down gradually we can change it into pressure-head. If the air left the blade with a velocity of 4005 ft. per minute and we were able to convert half the velocity-head into pressure-head we should obtain a pressure equivalent to that of half an inch of water. In the present example, a lot of head will be lost in shock when the air hits the casing.

We can control the amount of velocity-head with which we must deal by changing the curvature of the blades. See Fig. 5. In this figure we have a blade curved forward. V and U are the same as before, but v is seen to be increased. Moreover the air is leaving the blade in a

direction such that it will meet the casing without shock. The more air that flows through the fan the greater v becomes.

If we wished to make v very small, we could turn the blade backward. This is done in the case of the centrifugal pump, because with water it is difficult to change the velocity-head into pressure-head inside the pump.

ACTION OF THE FAN. So we have two sources of pressure: centrifugal force and velocity-head.

When a straight-blade fan is closed tight the pressure that we would expect to be developed is that of centrifugal force alone, because no air is flowing. We do, however, have the transient effect of the impact of the churning air against the outlet-gate. This impact-pressure disappears when the gate is opened.

As we let air into the fan, the centrifugal head remains practically the same and we have added to it such pressure as we may recover from the velocity-head in the air. When the gate is opened a little, the velocity of the air as it leaves the blade is nearly equal to the speed of the tip of the blade but very little is recovered on account of the turbulent eddies in the fan. As more air is admitted, the recovery becomes more marked. At all times enough velocity must be left in the air to carry it out of the fan at the desired speed.

I shall use the term 'over-all pressure' to signify the centrifugal pressure plus the amount of pressure we recover from the moving air in the fan-scroll.

When air is first admitted to a straight-blade or forward-curved-blade fan the over-all pressure rises for a time. Later, as more air is admitted, the velocity of the air leaving the tip increases, but we do not know how much of this is recovered, so we cannot tell whether the over-all pressure is increasing or decreasing.

The old long-blade coal-mine fan obtained its pressure primarily from centrifugal force. The blades were straight or curved backward. The type of fan found mostly about metal mines is the newer multiblade fan. Fig. 6 is a fan-wheel of this type. The blades are short and curved forward. These fans depend largely for their pressure not upon centrifugal force but upon giving the air a high velocity and then converting the velocity-head into pressure-head. To develop great centrifugal pressure, long blades are necessary, as we know from our study of the air in the revolving pipe.

From the energy equation of the fan we may deduce that the over-all pressure, as we have defined it, is equal to the static pressure produced at the outlet of the fan plus the friction of the air in flowing through the fan plus the velocity-head at the inlet. Now the velocity-head at the outlet of the fan is practically the same as the velocity-head at the inlet. So we may say that the over-all pressure overcomes friction in the fan, supplies the pressure to balance the mine resistance, and supplies the velocity to carry the air into the mine. This over-all pressure multiplied by the quantity of air delivered per minute is the power consumed by the fan in accomplishing the three objects stated. The actual power required to run the fan is a great deal more than this because

power is consumed in eddies, friction of the rotating air against the sides, and in bearing friction.

THE CHARACTERISTIC CURVE. To ascertain just how much pressure will be available for overcoming the mine resistance we may plot a pressure-volume characteristic curve of the fan. The data for such a curve are obtained as follows: Connect a few lengths of pipe to the discharge and place a gate at the end. Run the fan at constant speed. Take the pressure with a water-gauge at the fan-outlet. Start with the gate closed and record the pres-

sure. Now as we admit air to the fan, the air flows through the discharge, the impact-pressure is partly destroyed, and the conversion of velocity-head into pressure-head begins to take place. Friction of the air through the fan increases also. The increase in velocity-head recovered overcomes the increase in friction for a while, and the curve rises. Friction soon gets the better, however, and the curve begins to fall, and continues to fall until the gate is wide open. So in the case of a fan with long straight or backward curved blades we may

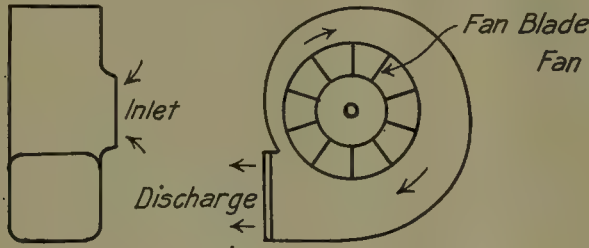


Fig. 1
Simple Fan

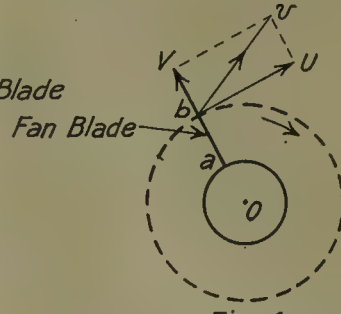


Fig. 4
Rotating Straight Blade

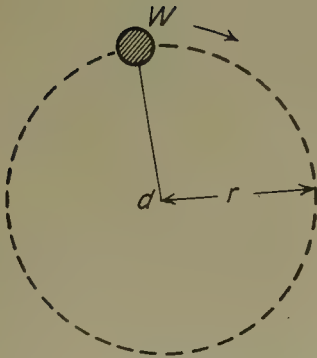


Fig. 2
Rotating Apple

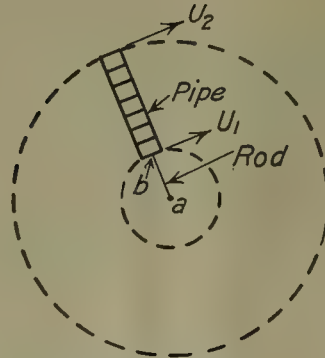


Fig. 3
Rotating Pipe
full of Air

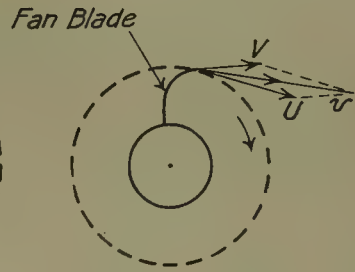


Fig. 5
Rotating
Curved Blade

sure. Open the gate a little, record the pressure, and measure the air flowing. Continue until the gate is wide open. Now, if we plot static pressure in inches of water against quantity of air flowing, we have what is called a pressure-volume characteristic curve. Fig. 7, A is such a curve for a straight-blade fan. For any given amount of air the pressure at which we may obtain that air is fixed and may be read from the curve.

If, as air is admitted to the fan, the over-all pressure increases faster than the friction in the fan plus velocity-pressure in the air leaving the fan, the characteristic rises. If the over-all pressure does not increase as fast as those other terms, the characteristic falls.

Let us study the curve of the straight blade fan, A (Fig. 7). When the fan is shut tight, the pressure is produced by the centrifugal force of the revolving air and by im-

say that most of the curve is falling so that as we admit more air to the fan the pressure at which we can obtain the air decreases.

Fig. 8 is the characteristic of a multiblade fan. It is difficult to explain fully the antics of the fan at the beginning of the curve. The multiblade fan has short blades, but when the fan is closed tight all the air in the casing is rotating, so we might expect a centrifugal head of $\frac{U_2^2}{2g}$ where U_2 is the speed of the blade-tip. But we sometimes find that the pressure under these conditions is more than twice this amount.

The great difference between the head produced by the multiblade fan and the straight-blade fan under the condition of no-air delivery must be due to velocity conversions from eddies and from greater impact.

When we let the air begin to flow through the fan the normal current is established through the fan and the churning and short circuiting are diminished. This causes a drop in pressure, until the proper conversion of velocity-head into pressure-head becomes effective, and the curve rises. Later, as in the case of the other fan, friction wins, and the curve falls until the gate is wide open.

ELECTRICAL ANALOGY. To those who understand electricity, I may perhaps make clear the general theory of the fan by using as an analogy a compound-wound direct-current generator with separately-excited shunt-fields. The series-coils are of course in series with the armature. This analogy, though not perfect, is close enough to be serviceable.

The total voltage produced by the generator corresponds to the over-all pressure of the fan. The IR drop in the generator corresponds to the drop in pressure in the fan. The terminal voltage of the generator corresponds to the water-gauge at the fan-outlet. The voltage produced by the shunt-coils is constant and corresponds to the centrifugal pressure produced by the fan. The voltage produced by the series-coils corresponds to the velocity-pressure recovered in the fan-housing. The current corresponds to the air. The more current that flows, the bigger the voltage from the series-coils and the bigger the total voltage. The generator characteristic curve corresponding to the pressure-volume curve of the fan is terminal volts against amperes. As we allow current to flow the total voltage increases and the IR drop through the generator also increases. If the gain in voltage due to the series-coils as current is increased is greater than the IR drop in the generator, the terminal voltage rises and the characteristic rises. If the gain in voltage is less than the IR drop, the curve falls.

FAN-RATING. Let us now look back at the curve shown in Fig. 7. We see that there are an infinite number of combinations of pressure and corresponding volume. What shall we call the capacity of this fan at the speed for which the curve is plotted? Laying aside for the moment the consideration of 'commercial efficiency', we would naturally say that this fan should be used at the point on the characteristic curve where it will give the highest mechanical efficiency. So if we plot a mechanical-efficiency curve on the same chart with the pressure-volume curve we may see at a glance at what combination of pressure and volume the fan should be used to give the highest mechanical efficiency. From the chart we see that this fan should be rated at 22,000 cu. ft. of air and 1.82 in. of water when running at the speed at which the chart was plotted. The method of obtaining the efficiency curve I shall discuss under fan-testing. If any element in the design of a fan is changed the characteristic changes, so in order to predict the action of a fan under a given set of conditions it is necessary for the engineer to obtain the characteristic from the maker.

The power to run a fan at a given speed constantly increases as air is admitted to the fan. When the fan is taking air at atmospheric pressure and discharging it at

atmospheric pressure, the entire over-all head is used up in fan friction and velocity. When this condition maintains, the fan has the greatest load that can be put upon it. I once asked a mine foreman what would happen if he left open the door between the inlet and discharge openings of an underground fan. He replied that the fan would race like an automobile motor when the clutch was suddenly thrown out. As a matter of fact, it would have put the maximum load on the fan and the motor might have burned out.

FAN LAWS. There are certain useful relations that exist between the speed of the fan and the pressure, quantity, and power when the mine-openings remain the same.

Experience has shown that with constant mine conditions the pressure produced by a fan rises as the square of the revolutions per minute, that is, if we double the speed we get four times the pressure.

It will be remembered that the mine pressure varies as the square of the velocity, so if we have four times the pressure, the velocity in the mine will increase by the $\sqrt{4}$ or 2. That is, we shall get double the air.

If we have four times the pressure and two times the air, it will take eight times the power to run the fan, provided the fan efficiency does not change; and it does not change, as we shall soon see.

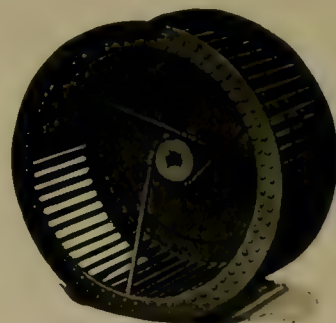


FIG. 6. MULTIBLADE WHEEL

To summarize: with constant mine-openings:

1. The quantity of air in circulation varies directly with the r.p.m.
2. The static pressure varies as the square of the r.p.m.
3. The power varies as the cube of the r.p.m.

The quotient obtained by dividing the static head produced by a fan by the velocity-head at the fan-outlet bears a peculiar relation to the efficiency of the fan, and for any particular design of fan the mechanical efficiency is highest when this quotient has a certain constant value. For example, suppose we have tested a fan and found it to be most efficient when the water-gauge is 2 inches and the quantity is 30,000 cu. ft. The fan has an outlet of 10 sq. ft. Let us determine the ratio of 'static' to 'velocity'.

The velocity through the fan-outlet is $\frac{30,000}{10} = 3000$ ft. per minute.

$$\frac{(3000)^2}{(4000)^2} \times 1 = 0.56$$

This is expressed in inches of water and is the velocity-head at the fan-outlet.

$$\frac{2}{0.56} = 3.6$$

So in this particular fan, when the ratio of static to velocity is 3.6, the fan is operating at the maximum mechanical efficiency. If this fan were operated under a condition that gave a ratio of, say, 2.5, the efficiency would be lower. In all cases when the ratio was 2.5 the efficiency would have the same value.

This brings us to the useful idea that if the mine-work-

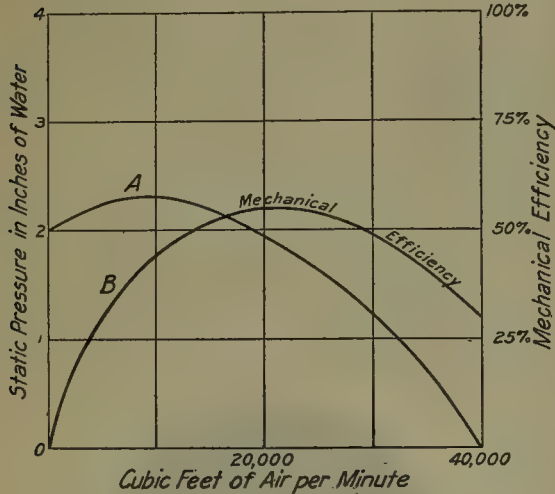


Fig. 7
Characteristic of Straight Blade Fan

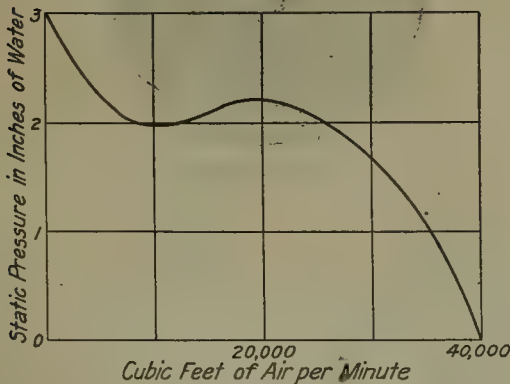


Fig. 8
Characteristic of Multiblade Fan

ings are unchanged, the speed of the fan may be varied without changing the efficiency, for if we double the speed we double the quantity, and hence we double the velocity through the fan-outlet. Doubling the velocity gives four times the velocity-head. Doubling the speed gives four times the static head, hence both static head and velocity-head are multiplied by four and the same ratio remains.

Let us next study the effect of a change in the density of the air on the operation of a fan. From the formulae for centrifugal pressure and velocity-pressure we see that the static pressure produced by the fan varies directly

with the density of the air. If we double the density, we double the pressure. From our study of mine resistance we recall that the resistance to the flow of air in the mine varies directly with the density, hence the resistance doubles if the density is doubled, so the fan at constant speed will circulate the same amount of air regardless of the density of the air, provided the mine-openings are unchanged. The power to circulate the air varies directly with the pressure, hence if we double the pressure and the quantity is unchanged, twice the power is required.

The density of the air varies directly with the absolute pressure and inversely as the absolute temperature. A fan running at a given speed on a given mine will circulate the same number of cubic feet of air in the summer as in the winter. It will take less power in the summer, because the air is lighter. It will circulate the same number of cubic feet when the barometer is high as when the barometer is low. It will take less power when the barometer is low, because the air is lighter.

A fan running under exactly the same conditions of speed and mine-openings will circulate the same number of cubic feet of air at all altitudes. The higher the altitude, the less power it will take.

Our discussion so far has been confined to pressure-fans. The theory of the exhaust-fan is the same, except for the fact that the air flows into the fan at a pressure below that of the atmosphere. The pressure at the outlet of the fan is atmospheric. The average density of the air in the exhaust-fan is lower than in the pressure-fan, but there is so little difference that the fan will produce nearly the same pressure exhausting as blowing under the same conditions of mine resistance and speed.

THE EXHAUST-FAN. It will be remembered that the over-all pressure produced by the fan comes partly from centrifugal pressure and partly from the recovery of velocity-pressure. With an exhaust-fan the air usually blows out into the atmosphere at high velocity. If we put a tall, gradually expanding chimney on the outlet we can slow down the air and change a lot of this velocity-head into pressure-head, and so make this velocity contribute to the difference in pressure which the fan maintains between the inlet and outlet. A fan that is circulating a given amount of air without a chimney will, if equipped with a chimney, circulate a larger amount of air with the same power, or the same amount of air with less power.

We have discussed the sources of the pressure produced by the fan, and now let us see what makes the air flow through the fan. Suppose the outlet is closed. A particle of air caught by the fan-blade at the inlet is started whirling. The air tries to go in a straight line, but it is held to a circular course by the fan-casing. The continual forcing of the air to a circular path is what makes the pressure we call centrifugal pressure. Now if we draw some air from the fan, the air gets a chance to work out gradually along the blade until it is thrown from the tip. When the air in the blade moves outward the pressure is reduced near the inlet and the pressure existing outside of the inlet forces new air into the fan to be in turn caught by the blade.

Recent Metallurgy at Trail, British Columbia

By F. H. MASON

Many additions, improvements, and enlargements have taken place at the Consolidated Mining & Smelting Co.'s plant, at Trail, since T. A. Rickard visited the plant in 1916, and wrote an account in the 'Mining and Scientific Press' of December 23 and 30, of that year, describing the operations as he then found them.

Although many smelting establishments in the United States are of larger proportions, Trail probably can boast of having the most versatile plant on the continent of North America, nor, as a matter of fact, is the equipment only of a metallurgical nature, for in its sulphuric and hydrofluosilicic acid plants Trail has branched out into the realm of what more properly should be considered as industrial chemistry. Today the Consolidated company is producing refined copper, lead, and zinc by electrolytic methods, as well as gold, silver, copper sulphate, sulphuric acid, hydrofluoric acid, and hydrofluosilicic acid.

The most extensive and by far the most interesting improvement at this plant is the development of an electrolytic zinc industry, which in a great measure has been evolved in order to treat the ore from the company's Sullivan mine, at Kimberley, in the East Kootenay district and 250 miles north-east of Trail. To attempt to give an average analysis of the Sullivan ore would be futile, for probably no two days run-of-mine would be the same; it is a heterogeneous conglomeration of compact sulphides, namely, blende, marmatite, galena, pyrrhotite, pyrite, and others, any one of which is liable to predominate, although in places comparatively clean patches of galena, blende, and pyrite are found in the mine. So closely, as a general rule, are these minerals blended, however, that under a powerful microscope a single grain that has passed a 200-mesh screen often may be seen to be composed of two, and sometimes more, minerals. The amount of gangue is negligible, rarely running up to as much as 6%. To the eye the great bulk of the Sullivan ore is an unpromising mineral that one would be prone to throw away as valueless, and even the richer samples, running between 30 and 40% in combined lead and zinc, is most unattractive stuff; and no one unfamiliar with the ore would judge that it contained anything like the amount of useful metals that the analysis reveals. Taken year in and year out, the ore probably will run between 15 and 20% of zinc and from 5 to 15% of lead, but such an enormous quantity of it has been proved that the management determined to spare neither trouble nor expense in developing a satisfactory process to treat it. S. G. Blaylock, the general manager for the company, places the probable ore-reserve safely in the millions of tons, but no definite figures can be given until further exploration has been made.

For the past ten years the company has been working

diligently to devise a process for the treatment of this ore, and, though the final process has not been selected definitively, at least two processes have been proved practicable. The process so far adopted may be divided into four distinct parts, namely, the mechanical treatment, or dressing, of the ore; the roasting of the product from the first treatment; the chemical treatment of the calcine, which, incidentally, is subjected to some mechanical treatment as well; and the precipitation of the zinc from solution.

The preliminary mechanical treatment of the ore is the only part of the process that really is still in doubt, whereas the chemical treatment, while it is likely to undergo slight changes from time to time, is quite beyond the experimental stage, for it has been proved beyond any question that, given cheap electric power, the electrolytic process for the recovery of the zinc can compete successfully with the old retort method. The company was experimenting with an electrolytic process for the recovery of zinc as far back as 1912, and it is believed that it was the first company in America to achieve success in this direction. It dropped the experimenting for a time, but took it up again before the commencement of the War, and it is not, as has often been stated, the high price of the metal during the War that made possible the evolution of the present process; as a matter of fact, the Consolidated company did not receive the high prices for zinc that were current during parts of 1916 and 1917 in the United States. The Imperial Munitions Board made a contract to take the whole of the Consolidated company's output at 15 cents per pound at a time when 27 cents per pound was being quoted for the metal in the United States.

To determine the best preliminary treatment for the ore, the company is running two experimental ore-dressing plants, the one a flotation plant, having a capacity of 400 tons per day, and the other a magnetic separation plant, with a capacity of 600 tons per day. These plants have superseded several other smaller experimental mills that were erected for the same purpose. The plants had not been tuned to capacity at the time of my visit, the greatest quantity of ore that the two of them had put through in a day being 940 tons.

The magnetic separation is based upon the removal of pyrrhotite magnetically, followed by the subsequent separation of the galena from the marmatite and blende on Wilfley tables. It has been found that the magnetic properties of the pyrrhotite in the Sullivan ore can be improved by a preliminary heat-treatment. The ore is crushed to pass a two-inch gauge, and the fine is separated from the coarse by a Mitchell electric screen; the coarse is passed through a cylindrical kiln, while the fine

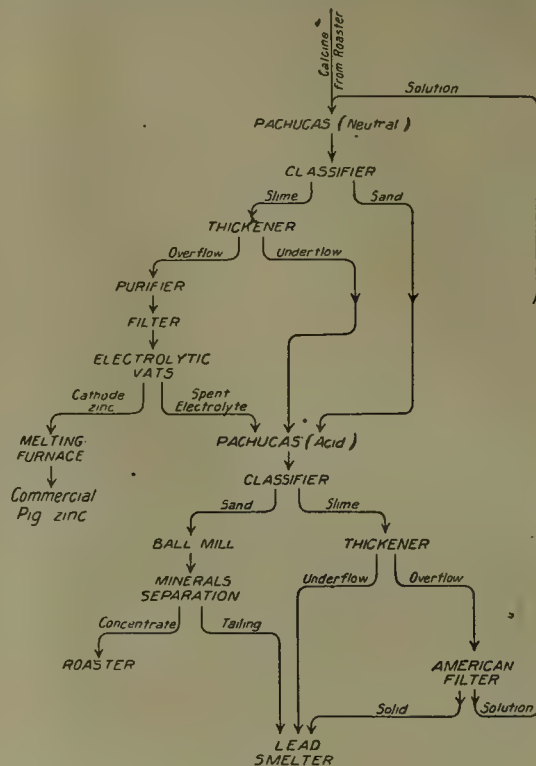
is carried by a belt-conveyor and mixed with the coarse after the latter has passed through the furnace. In this way the fine is not over-heated, as it would have been had it been passed through the furnace with the coarse. The temperature of the revolving furnace is about 1000°F. The fine and coarse are then passed through a revolving drum that is cooled by immersion of its lower part in running water. It has been found that unless the ore is thus cooled rapidly the improvement in its magnetic properties, caused by the heating, is not retained, while if, instead of being cooled in air, it is dropped directly into water the magnetic properties of the pyrrhotite are lost almost entirely. After this treatment the ore is ground in a ball-mill, and the pulp is passed over a Dings magnetic separator. This machine was designed for this particular ore, and to separate a wet pulp magnetically. Dry magnetic separation had been tried and had signally failed, but the wet method spreads the ore on a belt, enabling the magnet readily to pick up the magnetic particles, at the same time washing the non-magnetic particles out. The Dings magnetic separator consists of an endless rubber belt, similar to a vanner belt; as the pulp is conveyed along the belt it passes under a powerful electro-magnet, excited by a 15-ampere current. Between the magnet and the main belt is a narrow belt, which moves rapidly in a direction at right angles to the main belt and extends some distance on each side beyond both the belt and the magnet. The magnet attracts the magnetic particles of the pulp, attaches them to the under side of the narrow belt, which, when it gets beyond the magnetic field, drops the particles into a chute that conveys them away to be re-ground and re-passed over the machine. The pulp that passes the magnet is concentrated on Wilfey tables to separate part of the galena from the blende and marmatite; it is then thickened in Dorr thickeners, and de-watered by a five-leaf vacuum-filter. In this form it is sent to the roaster.

It must be remembered that while the plant is treating the Sullivan ore on a commercial scale, it is still in the experimental stages, and the product varies slightly from time to time with changes in the nature of the feed and with experiments that are being tried. For this reason, at the present time, the manager does not care to give out any figures as to the analysis of the product, as he considers such may be misleading. It may be said generally, however, that the concentrate is a satisfactory one, containing 25 to 30% of zinc and 12 to 15% of lead. This, it will be seen, is a great improvement on the original ore, much of which has been treated without any form of preliminary dressing other than hand-sorting for the recovery of zinc by the electrolytic method. The company is patenting the magnetic separation process.

At the other plant, the ore is crushed to pass a 20-mesh screen, concentrated on Wilfey tables, where a portion of the lead is removed, and then ground in a ball-mill to pass a 170-mesh screen. A screen-analysis of the pulp shows that 80% passes a 200-mesh screen, not more than 3% remains on a 100-mesh, and none on 45-mesh. The ground pulp goes to a modification of a Minerals Separation machine, using from 1 to 1½ pounds of mixed pine-

oil and creosote per ton of ore in a solution rendered slightly alkaline by caustic soda. At the time of my visit, the machine palpably was doing good work, for, while the original pulp was as black as coal, the concentrate that was coming away from the Minerals Separation machines was a rich reddish-brown color. The concentrate is thickened and dewatered in the same way as the concentrate from the magnetic machine.

Both methods of concentration are giving a concentrate that can be treated satisfactorily for the recovery of



FLOW-SHEET SHOWING TREATMENT OF CALCINED CONCENTRATE

both the zinc and the lead content. The magnetic separation plant does not remove the iron pyrite, and practically none of the small amount of gangue contained in the ore. On the other hand, it effectively removes all the pyrrhotite, in which form most of the iron of the ore occurs.

The products from both concentrating plants go to Wedge roasters, of which there are 13, each with a capacity of 40 tons per day. The temperature and conditions of the roast are regulated with a view to leaving about 3% of the zinc in the form of sulphate and the rest as oxide. The lead, of course, is roasted to sulphate. It has been found, as will be seen later, that if 3% of zinc is in the form of sulphate, it is not necessary to add sulphuric acid to the spent electrolyte, which is the solvent for the zinc content of the calcine; if, on the other hand, a greater amount of zinc is left in the form of sulphate, acid would have to be removed from the circuit, and, as the spent electrolyte after it has been through the pre-



THE TRAIL SMELTER; THE COLUMBIA RIVER IN THE FOREGROUND



THE ELECTROLYTIC ZINC REFINERY

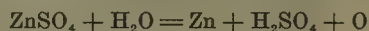
precipitating-vats still contains considerable of the original zinc content, the removal of acid would cause loss and endless trouble.

The solution of the zinc is the most intricate part of the process, as upon the purity of the zinc-sulphate solution formed depends the success of the subsequent precipitation of the metal. One of the most important points is that any iron that may be dissolved in the acid pachucas (or air-jet agitators) shall be kept in the ferric state, thus ensuring its precipitation by zinc oxide in the neutral pachucas. The solution of the zinc takes place in two batteries of pachucas, each battery containing five pachucas 10 ft. in diameter and 30 ft. high. One battery is known as the 'acid' and the other as the 'neutral' pachucas. The calcine is fed into the neutral pachucas, the zinc oxide precipitating any iron, arsenic, and antimony that may be in the solution; from the pachucas the calcine and solution go to a classifier; the slime from the classifier goes to a thickener, and the overflow from the thickener is treated with atomized zinc to precipitate any cadmium and copper that may be in solution. This is filtered, the filtrate going to the reserve tank and forming the electrolyte from which the zinc is precipitated. The thickened slime together with sand from the classifier and spent electrolyte is pumped to the acid pachucas. After treatment in these until practically all the zinc has been dissolved, the calcine and solution go to a classifier, and the sand from the classifier after it has been re-ground in a ball-mill goes to an M. S. machine, which acts as a cleaner to pick up any unroasted zinc and lead sulphide, which is returned to the Wedge roasters. The lead-iron tailing from the M. S. machine is dewatered and sent to the lead smelter for recovery of lead and silver. The slime from the classifier goes to a thickener, and the overflow is pumped to the neutral pachucas. The thickened slime is dewatered and sent to the lead smelter.

The two huge electrolyzing rooms, with their 53 rows of vats, each row containing eight vats, and each vat 18 anodes and 17 cathodes, is an imposing spectacle. The anodes are of sheet-lead and the cathodes are of aluminum. Each anode and cathode has an area of 10 square feet exposed to the electrolyte; a current of 25 to 27 amperes causing the precipitation of the zinc from the solution onto the cathode. The vats are arranged in steps, each one being a few inches higher than the one immediately below it, the electrolyte being siphoned down the row from the higher to the lower vats. After it has passed through the eight vats, and has been in contact with the 136 cathodes, it is pumped to storage-tanks, ready for re-use in the dissolving-house. The passage through the eight vats removes about 60% of the zinc content. The solution, of course, is used over and over again, being brought up to the proper strength, about 55 grammes of zinc per litre, by the solution of zinc oxide from fresh calcine in the dissolving-house. From 20 to 24 lb. of zinc is deposited on each cathode every 48 hours, at the end of which time the cathodes are removed from the vats. A tap on the top of the cathode loosens the zinc deposit, and with a chisel-edged tool a workman

strips a vat of cathodes in a few minutes. The cathodes are cleaned and replaced in the vats. The zinc deposit, as a rule, is even, compact, and firm; it is conveyed to the furnace-room, melted in a small reverberatory furnace, and cast into pigs. The dross is cleaned off the surface of the zinc from time to time, and cleaned from metallic zinc in a revolving shaker. The electrolytic product is the purest form of zinc marketed.

The chemistry of the reaction is expressed by the equation



It is probable that more water is decomposed by the current than the equation demands, and that the excess hydrogen is given off at the cathode while the oxygen is given off at the anode. The oxygen decomposes the small amount of manganese salts in the solution, precipitating manganese di-oxide on the anode, and about every two months this has to be cleaned off the anodes. The manganese di-oxide is slimed and put back in the solution, with the object of oxidizing any iron in the solution to the ferric state, and thus ensuring its precipitation by the zinc oxide in the calcine. The secret of successful operation is to keep the solution pure, especially free from iron and arsenic. This is accomplished in the dissolving-house by taking care that any iron that is dissolved from the calcine in the acid pachucas is maintained in a ferric state, thus assuring its precipitation by zinc oxide in the neutral pachucas. Traces of copper and cadmium are removed by atomized zinc, the reaction being one of simple replacement.

The electrolyte is caused to maintain a continuous circuit, zinc sulphate coming from the dissolving-room, this being a neutral solution, free from impurities that affect the reaction. About 60% of the zinc content is removed by its passage through the row of vats, and the electrolyte is returned to the storage-tanks as an acid solution, ready to dissolve a fresh quantity of zinc from the calcine. The calcine contains a little lime and a small amount of magnesia, which seem to escape removal by both concentrating methods. In the leaching-room the lime and magnesia are converted into sulphate, if, indeed, the reaction already has not taken place in the roaster; whereas the sulphate of magnesia and some of the sulphate of lime go into solution. They do not interfere with the electric precipitation of the zinc, and as they become concentrated they automatically drop out of the solution. I have said that the endeavor in roasting is to get a calcine with about 3% of the zinc in the form of sulphate. A larger quantity would be more disastrous than a smaller one, because it is simpler to add sulphuric acid to the circuit than to remove it. The electrolyte enters the zinc-precipitating vats containing about 55 grammes of zinc per litre and leaves them containing about 22 gm. per litre. This, of course, is readily brought up to strength again in the dissolving-room, but to remove some of the solution from the circuit because of an excess of acid would entail loss of zinc. It will be readily seen, too, that an excess of acid would upset the equilibrium of the circuit, preventing the precipitation of



THE ELECTROLYTIC LEAD REFINERY AT TRAIL



THE ELECTROLYTIC COPPER REFINERY AT TRAIL

iron, arsenic, and antimony by the zinc oxide in the calcine. A small amount of chloride is kept in the circuit to ensure the precipitation of any silver that may have been converted into sulphate in the roaster and to have gone into solution in this form.

Much of the ore being a zinc-iron mineral, some trouble was experienced in the early stages of the development of the process by the fact that a difficultly soluble zinc ferrate seems to have been formed in the roasting, but, by the proper regulation of the temperature and conditions in roasting, this difficulty seems to have been eliminated entirely.

Since the starting of the zinc plant up to the end of December last the company has produced 75,601,389 lb. of zinc, 30,743,461 lb. of which was produced during the 15 months ended December 31, 1919. The period of 15 months, instead of 12 months, is given here and elsewhere in this article because last year the company changed the date of the termination of its fiscal year from September 30 to December 31.

No great changes have taken place in the electrolytic lead-refinery since Mr. Rickard's visit. The metallurgical practice has been improved in many small details, and better work has been done than at any period during the past ten years. A uniformly high-grade product has been produced at a cost well below that which could be obtained by the Parkes process, working on the same tonnage. During the 15 months ended December 31, 1919, 41,711,147 lb. of lead was produced, bringing the total production since 1894 up to 538,882,617 pounds.

The copper refinery was dismantled at the time of my visit. Just at the present time, ore is not being shipped from the Consolidated company's Rossland mines, and concentrate from the Canada Copper Corporation's plant, at Allenby, which the Consolidated company has arranged to treat, is not expected to be coming in before August. The present, therefore, was an opportune time for enlarging the refinery plant, and the work of construction is well in hand. The old refinery had a capacity of 20 tons of refined copper per day; this is being increased to 50 tons per day. A copper-rod rolling-mill of like capacity is being added to the plant. The old anode-casting furnace has been torn down, and a new one of increased capacity is being erected. A satisfactory process has been demonstrated for the treatment of the lower-grade gold-copper ores of the company's Rossland mines, and, as a result, many years have been added to their life. A flotation mill of 200 tons daily capacity was run for several months on these ores, and proved beyond all doubt that they can be concentrated at a reasonable cost and with good recovery. Plans are well under way, and the ground has been broken at Trail for a concentration plant with a daily capacity of 1500 tons to treat these ores. For the 15 months ended December 31 the company produced 6,933,962 lb. of copper, bringing the total produced since 1894 up to 89,964,275 pounds.

The gold and silver refinery has been reconstructed and brought up to date. The refining of copper by the electrolytic method differs from that of lead in that, as the copper dissolves, the gold and silver, together with

the impurities in the metal, become detached from the anode and fall to the bottom of the vat. In the electrolytic refining of lead, on the other hand, most of the precious metals and the impurities adhere to the anode in a spongy form; consequently all the vats in the copper refinery are provided with traps in the bottom, through which the sludge is removed to receptacles below the vats. In the lead refinery only the end vat of each row has such a trap, the sludge being shoveled down the row into the last vat. The sludge passes through this trap onto a filter, where it is washed, and as much water as possible removed by a vacuum below the filter-bed. The sludge passes to a series of dryers that are arranged under the flue and are heated by the waste heat from the refinery furnace. When dry, the sludge is melted in a small reverberatory furnace and cast into bars. These bars, of course, contain all the gold and silver, together with a considerable amount of lead and copper, as well as impurities that were contained in the original anodes, the principal of which is antimony. The bar metal is melted and scorified in the same furnace until practically only gold and silver remain. The bullion is cast into bars. The slag is melted, made more liquid, and cleaned in the same furnace until it is free from shots of metal, and in this state it is either re-treated for precious metals or sold for its precious metal and antimony content.

The bars of bullion are parted by the sulphuric acid method in cast-iron kettles, 60° B. acid, which is made at the works, being used. When the silver is completely dissolved, the gold is removed, washed, dried, and melted in a crucible in an ordinary gasoline melting-furnace. The silver sulphate is diluted, and the silver is precipitated as cement silver by pig-copper. The cement silver is washed, dried, melted in a small oil-heated furnace, and cast into bars. The copper, which goes into solution as sulphate, replacing the silver, is concentrated in vats, and the copper sulphate is crystallized on strips of lead. During the 15 months ended December 31, 1919, the Consolidated company produced 59,605 oz. of gold and 1,782,025 oz. of silver, bringing the total since 1894 up to 1,891,443 oz. of gold and 30,496,067 oz. of silver.

In closing this article I desire to express my sincere thanks to the staff of the company for their courtesy in giving me access to the plant and in helping me in every possible way.

For some time past no copper, nickel, silver, or gold has been coined in Germany; iron and aluminum are used instead. During January 1920 the following subsidiary coins were minted and circulated: 3,340,870 marks worth of 50-pfennig aluminum pieces; 1,010,856 marks worth of 5-pfennig iron pieces. The total circulation of iron 5-pfennig pieces now amounts to 44,642,595 marks; circulation of iron 10-pfennig pieces, to 22,050,904 marks; of zinc 10-pfennig pieces, to 44,244,104 marks; and of 50-pfennig aluminum pieces, to 8,597,904 marks.

The Anaconda Copper company is testing a moveable drill-bit intended for use on a shaft of steel of cheaper grade. If found practicable the plan should save money.

A Volumetric Method for Determination of Tungsten

By GEORGE M. ENOS

*Those familiar with the usual gravimetric methods for the determination of tungsten, realize not only that there is much room for improvement in these methods, but that an accurate volumetric method would effect a great saving in time. Even a skilled analyst cannot complete an analysis by some gravimetric methods in less than ten or fifteen hours. It was with the idea of finding a shorter and at the same time accurate method that this research was conducted. Previous attempts to secure a suitable volumetric method have not been satisfactory and none is accepted as standard so far as I am able to ascertain.

When tungstic oxide, WO_3 , is reduced by heating to dull redness in a current of hydrogen, WO_2 is formed, which can be still further reduced to metallic tungsten, if the temperature is raised. WO_2 is a brown powder, and when formed in this manner is not stable in the presence of oxygen and must be cooled in a current of hydrogen. Tungsten may ordinarily be detected in minerals by boiling the finely powdered material with concentrated hydrochloric acid until insoluble yellow tungstic acid is formed. Zinc or tin is then added and if tungsten is present in appreciable amounts, a blue color appears in the solution or the yellow residue turns blue, due to reduction by the nascent hydrogen. This is the usual qualitative test. Reduction may be hastened by heating; if zinc be the metal used, the reduction may be continued until the brown WO_2 is formed. The blue color is believed to be due to the oxide W_2O_5 ; or more probably to a mixture of WO_2 and WO_3 . The brown color of the solution is due to the presence of WO_2 in suspension, it will settle out if exposed to the air. It is probable that some of the WO_2 is re-oxidized by air to WO_3 which is appreciably soluble in concentrated mineral acids, particularly hydrochloric.

Experiments tried showed that zinc is probably the only common metal capable of reducing the WO_3 entirely to WO_2 . Aluminum, tin, and stannous chloride in acid-solutions were tried, but the reduction gave solutions that showed only the blue color, even after long continued boiling. Titrations tried on the blue solution produced by reduction with aluminum in acid-solution, gave no agreeing results, indicating that a compound of definite composition was not present in the blue solution. The outline of the proposed volumetric method consists in acidifying a solution of an alkaline tungstate with sulphuric acid and the reduction of the tungsten from the hexa-valent to the tetra-valent state in acid-solution by means of a Jones reductor, and finally oxidizing the tungsten to the hexa-valent condition with a standard solution of potassium permanganate. This method has proved successful when certain precautions, which have

been carefully worked out, are observed. The accompanying cut of the Jones reductor shows the action of the solution, with the stages of reduction at different points indicated by the color changes. There is no reasonable doubt as to the completeness of the reduction.

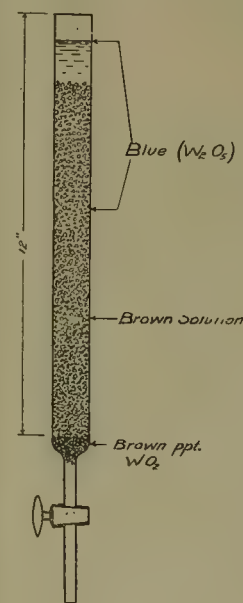
OUTLINE OF THE PROCEDURE. The tungsten is obtained in solution as an alkaline tungstate by any of the standard fusion methods. The removal of interfering elements may be accomplished by various methods. It may be pointed out here that in the procedure given below,

that iron, calcium, magnesium, and manganese will be removed by the filtration, and any copper or tin will be precipitated on the zinc in the reductor.

The following method is satisfactory in most cases:

Fuse 2.5 gm. of the finely powdered sample with 3 to 5 gm. of $NaKCO_3$ and 0.5 gm. of KNO_3 for not less than one-half hour, in either a platinum or a porcelain crucible. Dissolve the fused mass in hot water. Filter.

With some ores it may be advisable to make use of an alternative method of getting the material into solution. Where a large weight of sample is taken it is advisable to dilute the alkaline solution and take aliquot parts to be acidified and titrated.



THE REDUCTOR

Make the filtrate distinctly acid with H_2SO_4 and add 5 to 10 cc. in excess. The solution at this point should not exceed 100 cc. for best results. Heat to 80° to $90^\circ C.$, and pass through the Jones reductor at a moderate rate. The reductor should be washed with dilute H_2SO_4 and the washings discarded before the solution is passed through it. The solution above the zinc should show a deep blue color, and, when emerging from the zinc-column, a deep brown color. Wash with 50 to 150 cc. of dilute H_2SO_4 , being sure that all the brown precipitate of WO_2 is washed from the reductor. Finish washing with distilled water. Run the wash-solutions into the same flask as the main solution. Titrate at once with one-tenth normal $KMnO_4$. The percentage of WO_3 can then be calculated from the following equation:

$$\frac{\text{cc. K Mn O}_4}{\text{wt. of sample}} \times \frac{232}{2} \times N \times 100 = \% WO_3$$

To standardize, pure WO_3 was prepared by dissolving Merck's C.P. WO_3 in NH_4OH , precipitating with HNO_3 ,

*Abstract from the 'Pahasapa Quarterly'.

drying, and then heating to about 500°C. This material was kept in an air-tight bottle. The standardization of the procedure was then worked out on the oxide prepared in this way. The results are given in the following table.

Sample	W, by volumetric method	W, by calculation
	%	%
Pure WO ₃	80.02	79.3
Pure WO ₃	77.8	79.3
Pure WO ₃	79.6	79.3
Pure WO ₃	79.5	79.3

Several other determinations were carried out on different types of tungsten ore and the results are compared with the gravimetric results obtained by Ledoux's ammonia method in the following table:

	WO ₃ , by volumetric method	WO ₃ , by gravimetric method
	%	%
Scheelite (1)	59.51	59.60
Scheelite (2)	79.9	76.67
Tungsten sand	2.8	2.8
Wolframite (1)	62.6	62.5
Wolframite (2)	20.41	20.50
Wolframite (3)	45.8	45.95

NOTES ON THE PROCEDURE. Running dilute acid through the reductor first, produces an atmosphere of hydrogen, thus preventing oxidation of the tungsten in solution in the filter-flask by the oxygen of the air. The flask should not be disconnected from the reductor until everything is in readiness to titrate.

The solution passing through the reductor must contain enough acid to liberate hydrogen freely. No harm results if the solution shows a slight turbidity.

The temperature of the solution should be about 80°C.

The reductor must be washed clear of WO₃ with dilute H₂SO₄. The best results are obtained when a 2 or 3-normal solution of H₂SO₄ is used.

The volume for titration should not exceed 300 cc. and should not be cooler than 40° to 50°C.

The end-point in titrating is reached when the first permanent pink tinge appears. It is necessary to run a blank to determine the true end-point, since it requires an appreciable amount of permanganate to produce a pink tinge in 200 to 300 cc. of water acidulated with H₂SO₄.

The entire run on an ordinary ore does not take longer than three hours.

This method does not need platinum dishes, as no difficulty is encountered by fusing in porcelain, and no long evaporations are necessary.

The tungsten solution may be run into an excess of ferric sulphate where an equivalent amount of ferrous sulphate is formed which may then be titrated with KMnO₄.

It is also practical to run WO₃ into a measured quantity of KMnO₄, the KMnO₄ being in excess. Titrate the excess permanganate with standard ferrous sulphate.

OWING to the scarcity of radium—which is now priced at \$77,864 per gramme—and the failure to discover new sources of supply, it is feared the shortage will become

exceedingly acute. In the meantime, the Radium Institute in Great Britain is reported to be preparing radium for use in medical research by a strange method. A weak solution is made which gives off radium emanations; these, which are only detected by delicate instruments, are bottled into tiny glass phials and corked, and the phials are sent to medical men. It is stated that the efficacy of such bottled emanations lasts one week.

Smelting of Cyanide Precipitate

A feature of the refining at the Golden Horseshoe Estates mill in Australia is the use of gas-carbon in a Faber du Faur furnace. Gas-carbon is a by-product from gas-works and is practically pure carbon. It has great advantages as a fuel when compared with the best English coke, as it saves a considerable amount of labor, makes a large reduction in the fuel consumed, gives a higher temperature, and does not form any clinker in the furnace or on the fire-bars. When lighting the furnaces an abundance of wood must be used, and the gas-carbon fed in gradually until it is fully charged. It is necessary to light the furnaces about four hours before they are required. No addition of fuel is required to complete the smelt, and when the charge has been poured the fire-bars are withdrawn and the remaining gas-carbon is quenched with water, after which it can be used again. The consumption of fuel amounts to 1½ lb. of gas-carbon to 1 lb. of precipitate.

The precipitate contains:

	%		%
Insoluble	2.45	Lead oxide	9.05
Gold	21.06	Zinc oxide	21.65
Silver	19.98	Calcium oxide	6.80
Iron oxide	3.45	Magnesium oxide	0.61
Aluminum oxide	1.37	Sulphuric anhydride	6.64
Copper oxide	3.49		

To 100 parts of precipitate is added 30 parts of borax-glass, 8 parts of quartz sand, and 7 parts of manganese dioxide. This is thoroughly mixed on a concrete floor, but not sieved, as is sometimes practised, and is charged into the crucible by means of a specially designed chute. A No. 9 plain salamander crucible is used. It usually requires 2½ hours to complete each fusion, which, together with fluxes, weighs about 300 lb. Before pouring, the contents of the crucible are thoroughly stirred, the slag is collected in a slag-pot similar in design to those used in smelting works. The gold is poured into conical molds, any adhering matte is scraped off, weighed, and the bullion is re-melted in a No. 30 salamander crucible. When the bullion is molten, nitre is added and stirred thoroughly; the slag is thickened by the addition of mabor and skimmed off. These skimmings are subsequently treated by amalgamation. The bullion is cast into ingot molds which have previously been heated and coated with lamp-black by turning them upside down over some burning oily waste. The slag is removed from the bars while they are red hot, and they are further cleansed by plunging into a pickle bath, and then washed with fresh water. Finally they are scrubbed with carbonate of soda, washed, dried, and weighed. The fineness of the resulting bullion is gold 533.1, silver 435.6, and base 31.3.

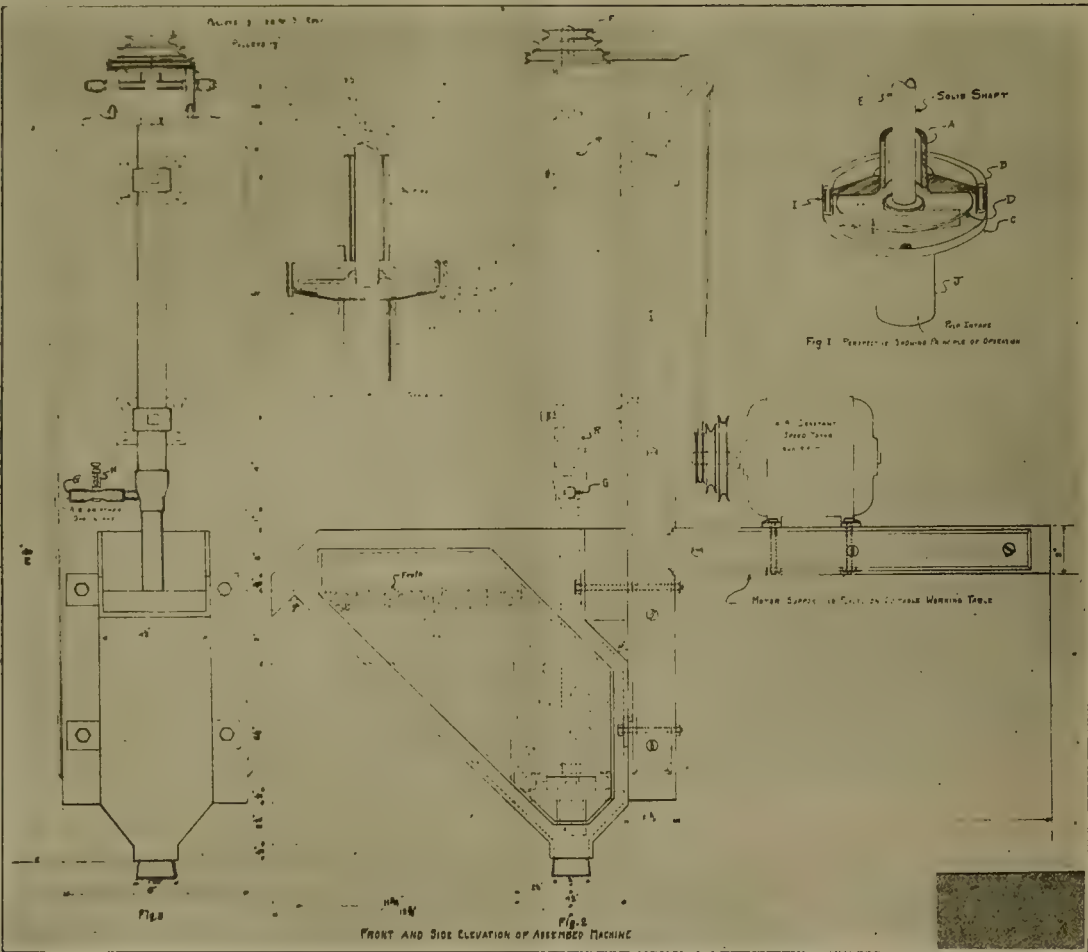
The Fahrenwald Flotation Machine

By FRANCIS A. THOMSON

Flotation machines are numerous. One criticism that may be leveled at nearly all of them, whether of the agitation or pneumatic type, is their high consumption of power. In the agitation type of machine this results from the fact that the entire pulp is kept in an unneces-

	Kw-hr. per ton of ore treated
Pneumatic machine	2 to 4
Janney "	4 to 8
M. S. "	4 to 6

As showing the relative consumption for various op-



DETAILS OF LABORATORY MACHINE

sarily exaggerated state of violent commotion in order to effect aeration and circulation, together with sufficient mixing to ensure complete distribution of flotation reagents and general homogeneity of the cell contents. In the pneumatic machine, consumption of power is due mainly to the inherent inefficiency of air-compression itself. The following figures are deduced from current practice:

Operation	Kw-hr. per ton of ore
Crushing and grinding	8.8
Gravity concentration	0.9
Flotation concentration	4.8
Conveying, elevating, dewatering, etc.....	3.8

The contrast between the power used for flotation and for gravity concentration is startling. Other comparisons of this kind would be interesting.

The consumption of power in the agitation type of machine can be reduced only by decreasing the amount of pulp under agitation at a given period. This is done in certain machines, such as the Ziegeler and Bunker Hill, in which only a portion of the pulp undergoes agitation at any one time.

A second consideration in the operation of flotation

parent than real and I am inclined to think that the Fahrenwald machine will in practice show several advantages not possessed by either of the other machines mentioned.

Fig. 1, 2, and 3 show the essential features of the machine. It consists of a stationary hollow tube *A*, to the lower end of which the upper and lower housings *B* and *C*, enclosing the impeller *D*, are suitably secured. The impeller is simply a revolving disc with vanes above and below; these vanes are set 90° apart and tangent to a

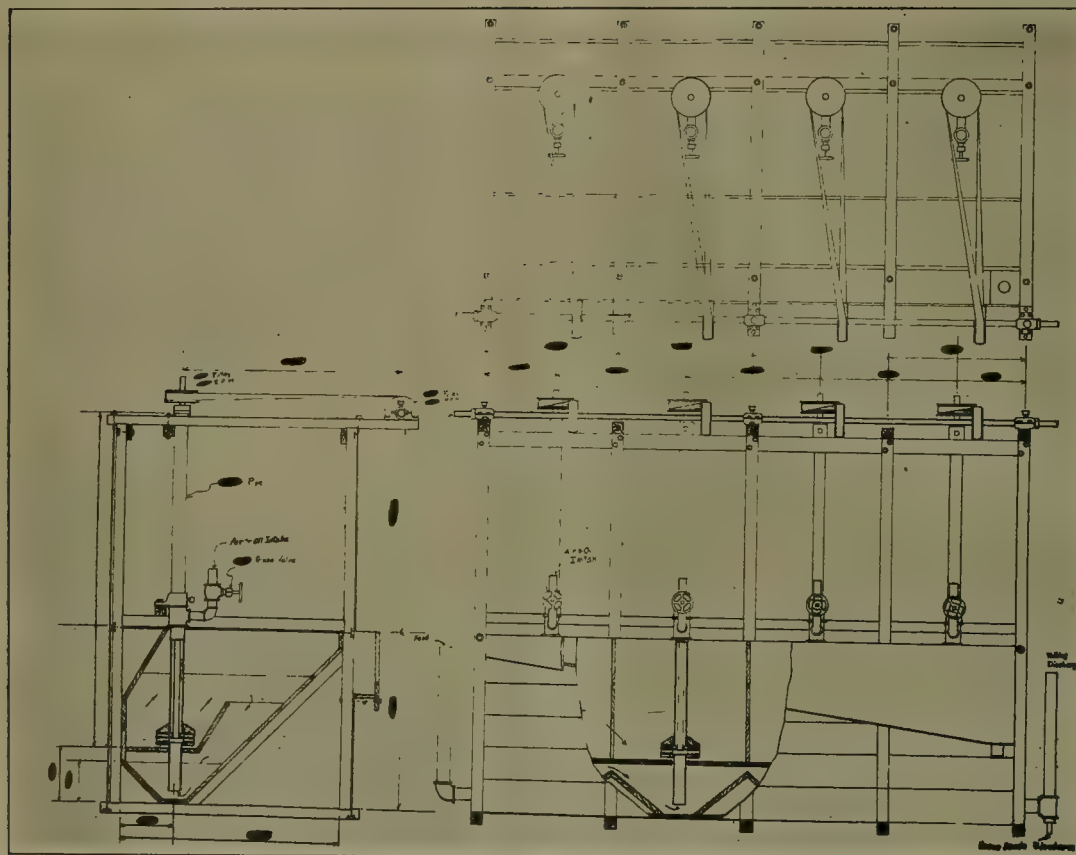


FIG. 4. FOUR-CELL MACHINE OF COMMERCIAL SIZE

machines is that the spitzkasten or frothing-chamber shall be as quiet and undisturbed as is consistent with proper aeration, circulation, and mixing.

These desiderata are in large measure fulfilled in a machine that has been developed in our* laboratory by A. W. Fahrenwald, a member of our faculty. The laboratory machine has attracted a good deal of attention and several experienced operators after seeing it in operation have arranged to have it duplicated for their personal use in testing.

From the accompanying drawings it might seem that the machine bears a close resemblance to the Ruth and Groch type. This resemblance is, however, more ap-

parent than real and I am inclined to think that the Fahrenwald machine will in practice show several advantages not possessed by either of the other machines mentioned. Fig. 1, 2, and 3 show the essential features of the machine. It consists of a stationary hollow tube *A*, to the lower end of which the upper and lower housings *B* and *C*, enclosing the impeller *D*, are suitably secured. The impeller is simply a revolving disc with vanes above and below; these vanes are set 90° apart and tangent to a circle one-third the diameter of the entire disc. There is a suitable hub on the upper side of the impeller by means of which it is secured to the solid impeller-shaft *E*, the other end of the shaft projects from the upper end of the pipe, and power is thus applied to it. This solid impeller-shaft revolves inside the hollow tube and is carried in suitable ball-bearings *R* secured within this tube. There is a T-connection just above the frothing-level through which air, oil, gas, or other substances may be admitted. Admission of air or other gas through this opening is under complete control of the operator through manipulation of valve *H*. Additional openings for any purpose may easily be provided. The lower housing *C* carries the suction-pipe *J*.

The operation of the machine is evident. Power is ap-

*The writer of the article is Dean of the School of Mines, at Moscow, Idaho.

plied to the impeller, and, as soon as the valve *H* is opened, air is drawn in on the upper side through the hollow tube and around the shaft, at the same time pulp is drawn up through the suction-pipe *J* and both air and pulp are delivered simultaneously at the periphery of the impeller. Circulation, aeration, and mixing are thus effected with a minimum expenditure of energy. The upper side of the impeller runs in air practically free from friction, the lower side of the impeller is in contact with but a small fraction of the pulp and there is none of the wild vortical, swirling, and eddying action characteristic of the usual paddle-agitator machines. Without the vortex in the paddle-agitator there could be no aeration, in the machine here described there is no occasion for a vortex and none is formed.

Efficient aeration with finely disseminated air-bubbles is the result of the action of the impeller. Air is sucked in by the action of the upper side of the impeller and as it leaves the housing it is drawn into the sheet of pulp which is continuously being discharged from the lower side of the impeller, thus affording maximum entrainment with minimum disturbance.

Fig. 4 shows the general construction of the machine as sold. A four-cell machine is shown, any number of these may be built in series to handle any particular given ore. Each cell is a unit and its operation may be cut out without greatly affecting the working of the machine. The aerating and circulating unit described above is so attached that in case of trouble it can be readily removed and replaced by a new one. The amount of aeration can be controlled in the various cells, which is of great importance in differential flotation.

The laboratory machine is designed to treat a 1000-gm. charge in a pulp-dilution of 4 of water to 1 of solid by weight. This is a convenient weight upon which to base calculations. Power is applied to the impeller with air-valve closed, and water is added to the machine until it reaches a level half an inch above the impeller. This forms a closed circuit of the pulp through the impeller from lower tube *J* and back to the main body of the pulp. The ore is now added to the machine, which brings the level up a little. With the pulp level $\frac{3}{4}$ to 1 inch above the impeller the maximum mixing effect is obtained. When the pulp has been thoroughly mixed with the reagents to be used, water is added to bring the dilution up to 4:1. This brings the pulp level up to within three inches of the overflow-lips.

The air-valve *H* is then manipulated to give the proper aeration, which can be adjusted to a nicety and a froth of practically any depth can be had. By regulating the valve, the froth can be made to overflow into the pan at any desired rate. This duplicates the automatic froth-overflow feature of the pneumatic type of machine. The froth can also be held below the discharge-lip and skimmed off as in other testing machines if for any reason this procedure is preferable.

If the ore is ground in a ball-mill, the reagents can be ground in or mixed with it and pre-agitation in the testing machine is unnecessary.

The Coke Industry During 1919

The outstanding features of the coke industry in 1919 were the great slump in demand that followed the Armistice and a remarkable increase in the proportion of by-product coke as compared with beehive coke. According to preliminary estimates made by F. G. Tryon, of the U. S. Geological Survey, the total production of coke in 1919, including beehive and by-product but excluding gas-house coke, was 44,821,000 net tons, a decrease, when compared with the production in 1918, of 11,657,000 tons, or 21%. The decrease was confined almost entirely to beehive coke, the production of which fell off 36%. The output of by-product coke decreased only 3%. The output of by-product coke consequently exceeded that of beehive coke for the first time. In 1918 about 46% of the total coke made in the United States was produced in by-product ovens and 54% in beehive ovens. In 1919 the proportion was reversed, 56% coming from by-product and only 44% from beehive ovens. The year 1919 thus marked a turning point in the history of coke manufacture in the United States. These figures are preliminary only and will be revised when the annual statistical canvass is completed.

The iron-furnaces are the great customers of the coke industry. In 1918 they consumed 45,704,000 net tons of coke, or 81% of the total output of beehive and by-product coke, combined. In 1919 the production of pig-iron fell off 22% and the demand for coke declined in proportion. The reaction was especially felt by the producers of beehive coke. With the growth in the output of by-product coke the beehive-coke industry is likely to become more and more an auxiliary source of fuel, carrying the peak load in times of extreme activity and being correspondingly restricted in times of depression. The post-war slump in the demand for beehive coke began to be seriously felt about March 15, and reached its lowest point in May. Thereafter production slowly recovered, only to be further interrupted by the steel workers' strike and the coal strike. As a result the production of beehive coke fell off 36% in 1919. All districts shared in the decrease. The total output in 1919 is estimated at 19,650,000 net tons. The total output of coke made in by-product ovens in 1919 was 25,171,000 net tons, a decrease, as compared with 1918, of 827,000 tons, or 3%. The increase was general and affected all States except New Jersey, Ohio, and Pennsylvania. The effect upon production of the decline in demand for by-product coke was largely counteracted by the completion of new plants. The rate of production was higher during January, February, and March than during the remainder of the year. During the last quarter the output suffered, as did that of beehive coke also, from the combined effects of the steel strike, which restricted demand, and of the coal strike, which curtailed the supply of coal.

During 1919 there were completed and put in blast 1228 new by-product ovens, of which 718 were at new plants and 510 were extensions at existing plants. One new State, Rhode Island, entered the ranks of by-product

coke producers in January, when the Providence Gas Co.'s plant was completed. During the year 128 ovens were either abandoned or were so re-built as to be classed as new ovens. On January 1, 1920, there were in course of construction 853 ovens, which were scheduled to come into operation by July 1, 1920. The maximum capacity of the by-product plants has been estimated at 27,000,000 net tons of coke at the beginning of 1918, 33,700,000 tons at the beginning of 1919, and 39,500,000 tons at the beginning of 1920. These annual capacities are estimated on a basis of 100% operation. In actual practice, however, an average operation above 90% cannot be assumed for the country as a whole, and the safer figure of 85% would appear better justified by experience. Under an operation of 85% the present capacity of the country would be about 33,600,000 tons. Completion of the plants now under construction may raise the capacity to approximately 43,300,000 tons, or 36,800,000 tons under an operation of 85%. Estimated according to the quantity of by-product coke produced in 1919—25,171,000 tons—the quantities of by-products recovered during the year amounted to 668,200,000 lb. of ammonium sulphate or equivalent, 251,000,000 gal. of tar, 84,800,000 gal. of crude light oil, and 367,700,000,000 cu. ft. of gas.

Production of Manganese

A preliminary statement of the production of manganese in the United States in 1919 and of the general present conditions of the industry has just been compiled under the direction of H. A. C. Jenison, of the U. S. Geological Survey. The general decline in the domestic production of high-grade manganese ore, which began early in 1919, continued throughout the year. During the last quarter the shipments of high-grade ore containing 35% or more of manganese amounted to only 4069 long tons. Most of this ore was shipped from Montana. During the same period the shipments of manganiferous ore containing 10 to 35% of manganese amounted to 120,243 tons. Of this quantity about 96,221 tons came from Minnesota, 18,240 tons from Nevada, 3965 tons from Michigan, and 1000 tons from Virginia. The shipments of ore containing 5 to 10% of manganese amounted to 24,921 tons, of which 24,597 tons came from Minnesota. The decline in imports that was noted during the summer of 1919 continued through the last quarter of that year, and the first two months of 1920 is marked by a further decline. The same conditions as prevailed in 1919 have persisted to the present time, and to them have been added low rates of exchange and domestic and foreign labor troubles. These conditions and the unfortunate state of European industry in general have seriously affected the foreign market for American steel and steel products.

In spite of the decline in the domestic production and in the imports of manganese the production of steel during the last few months has been made possible through the utilization of the stocks that accumulated during the period of large production. These stocks were sufficient

to meet the requirements of the steel industry for several months without further imports or domestic production. The reduction of the stocks has been accompanied by an increase in the price of nearly all grades of manganese ore and alloys, but, contrary to what might be expected, this increase in price has only slightly affected the domestic production, and imports have declined still further. According to the United States Shipping Board, there has been no shortage of ships nor is there any likelihood that there will be, and the freight-rates on imported manganese ore have decreased rather than increased. According to the best information available there has been no shortage of labor in the manganese-producing countries and, except in Russia, no apparent reason for the decrease in the export of ores to the United States. Since the 'nationalization' of the manganese deposits in regions dominated by Soviet Russia ore can be produced only by or under the direction of the 'Government', and none has been produced. Under normal circumstances the condition in Russia should have stimulated exports to the United States from Brazil, India, Mexico, Cuba, and Central America. With decreasing freight-rates, sufficient ships, and favorable internal conditions in manganese-producing countries, the reason for the decrease in imports can only be inferred. The practical discontinuance of imports and the almost negligible domestic production has enabled the holders of stocks to dispose of them at increasingly favorable prices. Large importation of foreign ore and alloys will no doubt be resumed when the stocks held in this country are sufficiently reduced. With any large increase in domestic production there would be probably a contemporaneous increase in imports which would bring the domestic ore into unfavorable competition with foreign ore. The continued critical condition of industry throughout the world introduces another factor which should be carefully considered. The market and the industrial conditions are sufficiently uncertain to make the resumption of domestic production a matter to be considered with great caution.

THREE tin mines in Bolivia have recently been acquired by American interests. The properties are known as Caracoles, Huanchaca de Inquisivi, and Pacuni, and are situated in the Department of La Paz, at a distance of about 65 miles from the Eucalyptus station of the Bolivia railway between Oruro and La Paz. The total area of these properties, which lie at an altitude of about 17,000 ft. above sea-level, is about 4000 hectares, and deposits are known to average from 10 to 15% tin. Already a centre of operations has been established at Eucalyptus, where 26 American engineers are engaged in the preliminary construction work both at the mines and on the road between the railroad and the properties. It is said that a road suitable for auto-trucks is to be built by the company and a hydro-electric plant for supplying the mines with power is to be one of the first projects to be carried out. Heavy machinery for this part of the development has already been purchased.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

RECEIVER ASKED FOR MILE WIDE COPPER CO.

JOHNSON.—The Keystone Copper Co. recently purchased 200,000 ft. of lumber for the construction of the new mill, and \$50,000 worth of machinery for the mine and mill has been ordered. The shaft has now reached a depth of 635 ft. and on the 125-ft. level a large body of 2 to 10% copper ore carrying gold and silver has been opened. It is expected that the mill will be in operation by the end of the year.

KINGMAN.—J. G. Keseler and associates netted \$229 from a shipment of 1600 lb. of ore obtained from location-work on a rich silver-lead deposit north of the Catherine mine on the Colorado river. The Hackberry Consolidated Mining Co. has purchased all of the equipment on the Senate Silver mines and it will be moved to the Combination property, which is situated to the north on the same vein as the Hackberry Consolidated Silver Mines Co. Sam Martin is superintendent of the Com-

binations. The shaft is north of the old orebody. Some copper ore has been found in the shaft. This property was the old McCracken mine.

A consolidation of the Arizona Rex and the Arizona Midway Mining Co. is being planned. These properties adjoin and are in the Silver Creek district, four miles north of Oatman.

TUCSON.—A receiver has been asked for the Mile Wide Copper Co. by the stockholders, who allege in their complaint that Charles P. Reiniger, president of the Mile



MILL OF THE PHELPS DODGE CORPORATION, AT MORENCI

bination mine. It is reported that a streak of ore assaying \$1100 over a width of eight inches has been cut in the new shaft of the Gold Button mine at a depth of 40 ft. This mine is in the Aubrey district in the Wallapai mountains. What is said to be one of the richest discoveries reported from the Wallapai mountains has been made on the Diamond Joe mine at a depth of 300 ft. Former operators of the property lost the ore on the level above through faulting. Sinking to the 300-ft. level, a small seam was picked up, and drifting on this has opened ore having a width of 18 in. The ore carries some copper and lead.

Sinking is now being continued in the 400-ft. shaft of the Campbell Consolidated mine in the McCracken moun-



SHATTUCK-ARIZONA MINE AT BISBEE

Wide Copper Co., capitalized at 1,000,000 shares at \$5 each, had used the company as a trustee to collect on the sale of the stock of the company, whose total capital stock had been transferred to him and others. The court is asked to decree that Reiniger stands in fiduciary relation to, and to be trustee for, the Mile Wide Copper Co.; that the issuance of the capital stock to Reiniger be declared null and void; that plaintiffs be decreed subscribers to the capital stock of the defendant company and entitled to stock there; and that a receiver for the protection of the rights of the parties therein pending be appointed. It asks further that Reiniger be compelled to account to the receiver for the bona fide stock and all real and personal property in his hands belonging to the company and purchased with money derived from the sale of its stock, and to turn over to the receiver all moneys received by him arising from the sale of stock; and that all shares of stock held by Reiniger be delivered to the company and cancelled.

The Gray Metals Co. has been formed to take over

seven claims in the Huachuca mountains owned by Douglas Gray, of Tombstone. This silver-lead-zinc property has been under development for the past seven years and there is considerable equipment on the property. Prominent business men are behind the new undertaking.

COLORADO

NEW EXPLORATION PLANNED FOR CRIPPLE CREEK.

CRIPPLE CREEK.—Exploration by diamond-drill of the area north-east of the present producing section, by a syndicate of prominent operators, has been arranged and will commence as soon as the contractors have their equipment on the ground. The theory advanced by W. H. Trask of Denver, owner of the Pride of Cripple Creek mine on Ironclad hill, is that approximately 5000 acres in the Gillet section, has a granite capping overlying the eruptive, resulting from a series of flows or slides from the vicinity of Pikes Peak, while the crater was still open and contained molten material. This theory was presented to George Stahl, general manager for the Vindicator company, and to A. E. Carlton, with the result of the organization of a syndicate backed by the Cresson and Vindicator companies. Bulkeley Wells, manager of the Smuggler Union at Telluride, Harry W. Robinson, well known mining attorney of Denver, and others. Acreage has been acquired and contract for drilling let. If the eruptive is entered at reasonable depth below the granite, a working shaft will be sunk and extensive horizontal holes drilled from the bottom of the shaft to find possible ore. Development work and operation will be under the direction of W. R. Ryan, general superintendent for the Vindicator company. Egildson Brothers, diamond-drill contractors of Wyoming, have been awarded the contract and their outfit is now on the way to the district.

Ore sampling 8 oz. gold per ton has been opened up south of the Jerry Johnson shaft at the 6th level, 750 ft. from the surface by F. G. Horn, lessee. This ore is the farthest south yet discovered in the mine. The War Eagle Consolidated Mines Co. has erected an ore-house near the shaft of the Blue Flag company on Raven hill and is hoisting ore from the shoot on War Eagle territory opened up at the Moffat tunnel level, through the Blue Flag shaft. On the South Burns claim of the Acacia company, Bull Hill, the company has opened up a strong vein of milling ore at the 1400-ft. level. Development is in progress by H. L. Le Brun, lessee, at the 1500-ft. level. Milling ore has been opened up in the New York tunnel on the western slope of Bull hill. The property is operated under lease by Colorado Springs capitalists. Stewart Cox and associates have opened up shipping ore on the Pinto mine of the Free Coinage company, on what is believed, the extension of the Maloney vein found on the Empire ground, Isabella Mines company, adjoining.

SILVERTON.—A large tonnage of silver-lead ore will be shipped from the Mountain Queen in California gulch, from the orebody opened last fall. The shaft was re-timbered before the winter shut-down, in readiness for

heavy production this year. A Cleveland, Ohio, syndicate operating the Fraction is breaking ore and will start shipping as soon as the new hoisting plant is completed. The Seaton Mountain Mining & Leasing Co. is mining ore with high silver-lead content and shipping to the smelter. Both the Cleveland and Seaton managements are paying a bonus to every man working 30 days.

BRECKENRIDGE.—Gold ore has been shipped from the Dunkin by lessees, and the Nels Olstrum lease on the Iron Mask is shipping lead carbonates. The Breckenridge Mining & Cyanide Co. shipped a consignment of rich ore from the Fox Lake and Ira Roberts properties in Yuba Dam flats to the A. & V. smelter at Leadville. Prospectors are getting out in the hills as the snow melts and are preparing to work on mines that produced silver ore when last operated.

MICHIGAN

SENECA CONTINUES SINKING.

HOUGHTON.—Seneca's shaft continues to go down toward the 5th level. The output is averaging better than 350 tons per day now. Of this, 250 tons is coming from the openings on the 3rd and 4th levels. All four of these openings are in 120 ft. from the shaft and the quality of the ore persists. It is fair to say that the general run of material mined during the past ten days will show 25 lb. per ton. When the 4th level laterals are run, further stoping will commence and within 30 days the Seneca tonnage will be derived from the underground openings, provided they maintain the same grade, as seems altogether likely.

At the Gratiot the drift on the 15th level to the south has attained 190 ft. from the shaft. It continues in material which is to be tested at the stamp-mill in separate tests. This lode appears to have the characteristics of the Kearsarge, including much copper. Just what it will average is a matter of much interest and some speculation.

Quincy is building a crushing-plant at the smelter. This will be utilized for the purpose of grinding the brick that is taken from the inside of the furnaces. This brick becomes impregnated with copper, following long continued usage. The experiments have shown that this ground-up brick not only produces considerable copper, but the product makes an entirely satisfactory sand to use in new charges in the furnaces.

Calumet & Hecla is extending its electric-power lines for the purpose of carrying high-power voltage to the associated mines at the north end of the county. These lines now are being run from Laurium toward No. 4 Kearsarge and later on will go to the Ahmeek and the Allouez mines. The more general use of electric trams underground requires additional power underground. The Ahmeek has added to its use of electric trams; so has the Allouez, and at the old Osceola the long hauls running over into the La Salle territory, which continues to maintain a good tonnage of the best grade of Osceola lode 'rock' that is taken out anywhere in the district, require electric power. The only construction

work that Calumet & Hecla is doing at present is underground haulage on the conglomerate at the 83rd level. The flotation-mill improvement and the proposed remodeling of the smelter have been held in abeyance owing to the difficulty in securing labor and the high cost of material entering into the construction account.

At the new Baltic shaft of the Arcadian Consolidated property the cross-cut on the 500-ft. level back to the vein is well under way, following the unwatering of the shaft. There is reason to believe that the vein will be tapped within a week, if the present rate of progress is maintained. On the 400-ft. level work will be resumed at once. This is the level where the showing of copper

company. Work on the 300, 400, 500, and 625-ft. levels, where large tonnages of ore have recently been opened, will be the first step in this program. According to expectations the capacity of the mine will be doubled. This will give employment to 250 men instead of 150 employed at present.

NEVADA

DEEP SINKING PLANNED FOR DIVIDE DISTRICT.

ARROWHEAD.—The Arrowhead shaft has been sunk 45 ft. from the 175-ft. level and it is to be continued to 300 ft., with a level at 250, according to present plans. The ore-shoot is 5 ft. wide and assays 45 oz. silver and \$4



THE SAN JUAN MOUNTAINS, COLORADO

was so spectacular. Arcadian had a little trouble getting coal, but this problem has been solved, temporarily at least.

MONTANA

WORK SUSPENDED AT NEIHART.

NEIHART.—The mines in this district are idle following a demand for a wage-increase of 50c. per day. The men walked out without giving the mine-owners any notice of the strike action. The mines affected are the Cascade Mines & Mills Co., Neihart Consolidated, Neihart Silver Mining Co., and the Florence and Gault properties. The mine-owners followed the action taken by the Butte mines by immediately announcing that no more I. W. W. members will be employed in the district. All future applicants will be thoroughly investigated along these lines. It is claimed that the leaders of the local strike were also active in the recent strike of miners in Butte.

H. G. Palsgrove, of Denver, has been appointed manager of the Cascade Silver Mines & Mills Co. to carry out the development program which has been outlined by this

gold at the bottom of the shaft. Shipments that have an average value of \$75 per ton are being made to Tonopah from the 100 and 175-ft. levels. The ore will be milled at Tonopah instead of being shipped to a smelter as was at first planned. The Syndicate is cross-cutting 50 ft. to the Arrowhead vein at a depth of 200 ft. The cross-cut is 25 ft. long. The Consolidated shaft is 200 ft. deep and a cross-cut is to be driven to the vein at 215 ft., or 100 ft. below the first level. Ore 12 ft. wide and assaying 15 to 20 oz. has been found in the west drift on the 115-ft. level and in the east drift there is 18 in. that can be shipped at a good profit. The Extension is cross-cutting to the vein at 150 ft. The Inspiration is to sink a new shaft. This company is now working through a 50-ft. shaft and a tunnel. The West Arrowhead shaft has entered a cross-vein at 100 ft. Sinking is being continued.

TULE CANYON.—The Silver Hills, operating the Ingalls mine under option, is building a 5-stamp cyanide mill, which, with the old plant, will give a total capacity of 50 tons daily. The average grade of ore being milled

is \$30 to \$35 and a saving of 80 to 90% is being made. The 100-ft. shaft has been re-timbered, the surface plant is in place and sinking will be started within a week. The Silver Hills is the only company working in the district. No work has been done in the placer field since early last fall.

VIRGINIA CITY.—The Paramount Mines Co. has been organized by Herbert Humphrey and associates to develop above the 1000-ft. level the Gould & Curry, Best & Belcher, and Savage. The opening of high-grade ore at 190 ft. by the South-west Comstock Extension, proving ore in this direction from the old producers, and the organization of the United Comstock Mines Co. to operate on a large scale near the surface of the Gold Hill mines has revived interest in the possibilities of the old mines and the surrounding section, and there are indications that the entrance of men with new plans of development will lead eventually to a big increase in the production of the noted old district that has been decidedly inactive during the period of low-priced silver.

DIVIDE.—Future work of the Tonopah Divide company will be supervised by G. H. Garry, consulting engineer for the Tonopah Belmont, and William Watters has resumed his former position as superintendent. The mine will be re-sampled. The shaft is 825 ft. deep and it is planned to continue sinking until the water-level is reached. A new 112-hp. hoist that lifts $3\frac{1}{2}$ tons 600 ft. per minute is now in use. The south-east drift on the 585-ft. level is 720 ft. long. The shoot of sulphide ore recently opened in this drift is "at least 26 ft. long" and has an average value of \$26, according to the last weekly report. "The shoot has not been cross-cut. Several other Divide companies plan to sink shafts to not less than 1000 ft. The formation in most parts of the Divide district for several hundred feet from the surface is hard fine-grained rhyolite, the 'cap-rock', and tens of thousands of feet of work was done in this unfavorable formation during the boom, due largely to the anxiety of the managements to 'start cross-cutting to the vein' because of the effect this had on the price of the stock. It has been proved that work in this formation was wasted and that the shafts must be sunk far into the rhyolite breccia before paying orebodies can be expected. Engineers think prospecting at 1000 ft. may have good results. The Dividend has started work at 800 ft. and the Brougher shaft is to be sunk to 1000. Among the companies planning to sink to 1000 ft. are the Sutherland and Reco, in the far northern part of the district.

GOLDFIELD.—The Development mill is ready to treat 100 tons of ore daily and shipments will be started from the Cracker Jack leases on the Florence and other sources of ore when the Interstate Commerce Commission approves the rate schedule of the Tonopah & Goldfield railroad for hauling. There has been found in the Cracker Jack lease, 40 ft. above the 500-ft. level, a 2-ft. width of ore assaying \$100. The shoot has been opened for a length of 30 feet.

UTAH

NEW ENGLAND MINE AT BINGHAM RESUMES OPERATIONS.

BINGHAM.—Operations at the New England mine will be resumed at once by a syndicate of Ohio, Pennsylvania, and New York men, who have taken over the property. The new company has been named the Utah-Boston Development Co., incorporated under the laws of Maine, for \$500,000. Purchase of the property was made for the syndicate by Robert M. Hampton, mining engineer of Tonopah, Nevada. The New England property was originally known as the Nast mine and had a production record of about \$550,000, which had been mined up to 1901, when the New England company purchased the mine. During the ownership of this latter company, production was increased to \$1,500,000, all of the ore having been mined from above a vertical depth of 200 ft. Since 1912 the property has been idle and the company involved in litigation. The property consists of approximately 50 acres of mineral ground, surrounded by the Utah Copper, United States Mining, and Utah Metal & Tunnel mines. Plans already made for the new company's operations provide for the development at depth of the already proved ore channels. The property is opened by a tunnel from which a shaft has been sunk. The shaft will be sent down an additional 500 ft., and a raise will be made in the shaft from the tunnel-level to the surface, giving a vertical depth of 800 ft. While the shaft is being sunk, production will be started from a known shoot of ore on the lowest level. Shipments made from this shoot in 1906 and 1907 are reported as averaging \$40 per ton, so with present metal prices, it will be considerably more valuable. Equipment on the property will be overhauled at once and new electrical hoisting equipment placed at the new shaft. A ten-drill compressor on the property will be repaired and started at once.

ALTA.—Shipments of ore from the Columbus Rexall property have been resumed. In the north end of the property, near the face of the main tunnel, it is estimated that there is 5000 tons of ore. Nearer the portal of the tunnel, in a raise, the company has 20 ft. of ore, which will not be taken out until square-sets arrive with which to mine it. The company has in its ore-bins, awaiting shipment, about \$25,000 worth of ore, while the 'ore in sight' is estimated at \$250,000. The holdings of the company in this camp total 112 acres, with an outstanding capitalization of 586,235 shares. The major portion of mining operations have been conducted at a vertical depth of 900 to 1000 ft., and at a distance of a mile from the portal of the tunnel. In addition to the adit, there are connections with the Frederick tunnel and with the 600 and 800-ft. levels of the Cardiff mine, affording ventilation and additional exits in cases of emergency. M. R. Evans states that operations will be conducted on a larger scale this summer than has been attempted heretofore.

PARK CITY.—According to rumors, the Judge Mining & Smelting, the Daly-West, and Daly Mining companies are considering the erection of a mill on the flats below

town. While officials of the companies have nothing to say, others in a position to know state that the plan is under advisement. All three of the properties have thousands of tons of milling ore, and it is probable that if such a mill were constructed, the Park-Utah property would also join in the combination.

The Keystone property is reported as being in excellent condition. This mine is being worked through the Hanauer tunnel and the Kearns-Keith shaft. Before development work could be started, the tunnel had to be cleaned out for a distance of 4200 ft., and the shaft repaired for a distance of 250 ft. In a drift from the shaft, one of the big fissures of the district was cut and more than 20 ft. of good milling ore and considerable first-class ore opened. In a drift from the third level of the Columbia raise, several feet of exceptionally high-grade shipping ore, which carries gray copper and better than 100 oz. silver per ton, has been opened up. More than 500 tons of high-grade ore is stored in the bins at the mine, awaiting shipment. All of this ore came from prospecting work and no attempt has yet been made to stope any of the ore-shoots which have been opened. The roads in the vicinity of the Keystone are now getting in such shape that teams will be able to reach the ore-bins and operations at the property can be speeded up.

EUREKA.—The old water-line of the Eagle & Blue Bell Mining Co., extending from the company's wells at Homansville to the mine, is to be taken up, after having been in service nearly 30 years. The line is 7700 ft. long and contracts have been awarded for the uncovering of the old line and laying the new one. According to B. F. Fleiner, the Imperial Lead Co., in the West Tintic district, has been a steady producer for several months past; the ore being hauled by truck to Sugarville station on the Salt Lake Route. The Imperial Lead is owned by Salt Lake City interests. The mine has been a shipper for the past two or three years, but operations were not started on an extensive scale until late in 1919, with continuous production during the past winter and spring.

Recently the lessees who are at work at the old Sunbeam mine finished the job of re-timbering and cleaning out the shaft to a depth of 450 ft. This latter depth was the deepest point reached in the property when in operation some 20 years ago. E. R. Higgenson, mining operator of Salt Lake City, is in charge of the property and a total of 52 cars of ore has been shipped under his management. Recent smelter returns show the ore to be worth approximately \$50 per ton. Mr. Higgenson expects a better grade of ore when mining is resumed on the 450-ft. level.

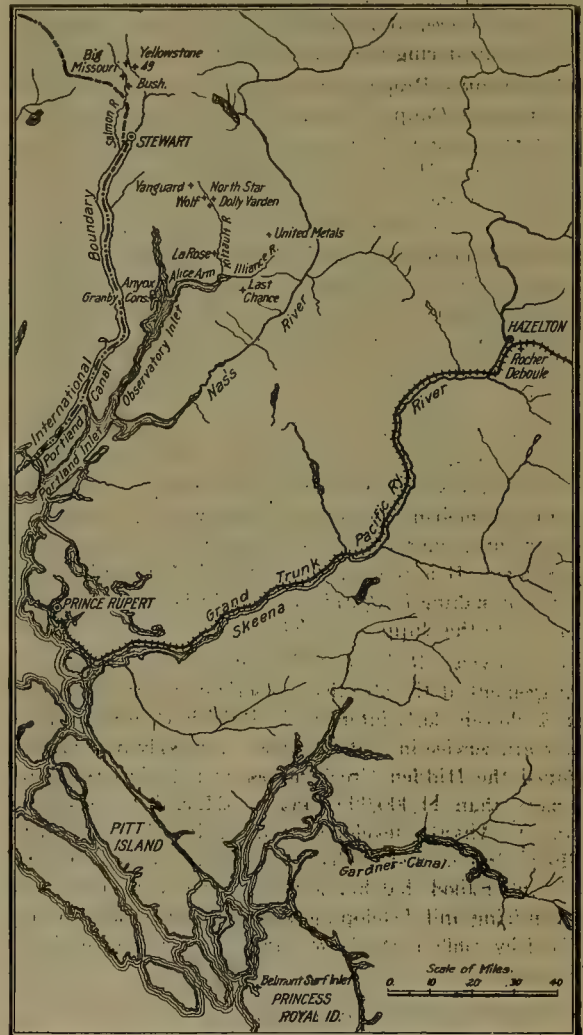
BRITISH COLUMBIA

WORK RESUMED AT THE DOLLY VARDEN.

ALICE ARM.—A syndicate has been formed to explore and, if investigation proves satisfactory, to develop the Royal group of claims, adjoining the Dolly Varden mine. This property consists of seven claims held under a \$100,000 bond. It is conveniently situated as to transportation, a short aerial tramway being all that would be neces-

sary to connect it with the Dolly Varden railway. A settlement of the strike of employees of the Dolly Varden has been effected. It is stated that practically all the demands of the men were granted. Mines will be paid at the rate of \$6.25 per day; muckers, \$5.75; and trackmen, \$5.75. The union scale also will apply to cooks, mechanics, and other employees.

QUEEN CHARLOTTE ISLANDS.—George Clothier, Government mining engineer, has just finished an examination



MAP OF SOUTH-WESTERN BRITISH COLUMBIA

of some prospects of the Queen Charlotte Islands. He went over a free-milling gold property situated near Skidegate on the west coast of Morseby island and states that further development is warranted. The Ikeda mine near Jedway is to be opened up this season and it is reported that a concentrator is to be built. Quantities of high-grade copper ore have been shipped at various times, and there now is a good deal of comparatively low-grade ore on the dump which, if facilities were available at the mine, might be treated at a profit. Surface work is

being done on the Southeastern mine in the same section and another property near Jedway is being inspected and reported upon by representatives of the American Smelting & Refining Co.

NELSON.—The McAllister mine at Three Forks is under development with promising prospects. R. A. Grimes, manager, states that the Sloean strike did not close down the work he has under way. This mine may be expected to join the shippers of the silver-zone of British Columbia at an early date. Some first-class ore has been uncovered and those interested are so well satisfied with the outlook as to be considering the purchase of further plant.

PRINCETON.—Preparations for the commencement of operations at Copper Mountain by the Canada Copper Corporation are well advanced. Trains already are running between Princeton and Allenby on the Copper Mountain branch, of the Kettle Valley railway. The concentrator has been completed and awaits the power which is being brought over a high-tension line from Bonnington Falls by the East Kootenay Power & Light Co. A large brick power-station has been constructed. H. R. Van Wagenen, general manager, has returned and it is expected that the mine and mill will start work in September.

ROSSLAND.—The Velvet mine, situated near Rossland, is being re-opened by H. E. Innis, of Sandon. Some months ago it was taken over by the Granby Consolidated Mining & Smelting Co. and the mine was unwatered and worked for a short time. The company, however, ceased operations. It is well equipped and, if Mr. Innis is successful in making it a producer, should become a valuable addition to the shippers of the camp.

VANCOUVER.—R. F. M. Sylvester has retired from the management of the Granby Consolidated Mining, Smelting & Power Co.'s interests in British Columbia, after ten years service in that capacity. Mr. Sylvester has developed the Hidden Creek mines with their ore-reserve of more than 11,000,000 tons, established the smelting plant at Anyox, developed and equipped the Cassidy colliery, and erected the by-product coke-ovens at Anyox. It is understood that his policy of expansion in the way of acquiring and developing other properties was not approved by some of the New York directors, hence his retirement.

ONTARIO

DISCOVERIES AT BEAVER HOUSE LAKE.

PORCUPINE.—Advance information as to the annual report of the Dome Mines for the year ended March 31 places the net profit at approximately \$650,000, after liberal allowances have been made for 'deferred development' and depreciation. It is stated that the mill-heads averaged \$6.50 per ton and that operating costs were between \$3.50 and \$3.60 per ton.

KIRKLAND LAKE.—The downward continuation of the orebodies found on the 300-ft. level of the Ontario Kirkland has been proved, assays of ore from the 450-ft. level showing gold content of \$16 per ton. The company has

contracted for the construction of a mill, the size of which will be determined by the results of further development. Development work has been resumed at the Granby-Kirkland, where the shaft on No. 1 is down 18 ft., the vein at that depth showing a width of 8 ft. At the Fidelity property the shaft is down 192 ft. It is being driven on an incline following the vein, which maintains its width. A small vein four inches wide has come in along the foot-wall side of the shaft.

BEAVER HOUSE LAKE.—Important discoveries of gold are reported to have been made on the south side of the lake about one mile from the Argonaut, causing a rush of prospectors and the staking of many claims in the locality. Recent developments at the Argonaut are of an encouraging character.

TORONTO.—The alleged inadequacy of the taxes paid to the Province by the International Nickel Co. has been the subject of frequent attacks on the Provincial government, which were renewed by the Liberal opposition during the session just closed. While apparently satisfied with present conditions, the assailants contended that the arrangement made by the former government under which the company paid a flat rate of \$40,000 per year for the years 1911 and 1915 was illegal, and that the Province was entitled to recover from the company the arrears of taxes properly payable for this period. A resolution introduced to that effect was withdrawn on a promise by Premier Drury that an investigation into the matter would be held.

COBALT.—Shipments of bullion have resumed normal proportions from Cobalt, although more than 1,000,000 oz. lies stored in the vaults at the leading mines. This is held on the strength of the belief that quotations for the metal will at least remain at the present level, with some likelihood of advances.

The Coniagas Mines has leased the cyanide equipment in the mill on the Buffalo company, and will treat approximately 40,000 tons of tailing which lies on the Coniagas close to the Buffalo boundary. The lease does not include the oil-flotation equipment in the Buffalo mill. Announcement is made that the Cobalt companies will continue to pay their employees a bonus of \$1.25 per day. The schedule of wages as agreed upon last fall amounts to \$3.50 for loaders and \$4 for machine-runners, plus a bonus of 25c. per day when silver averages 80c. per ounce, and an additional 25c. per day for each 10-point advance. During the early months of this year the price averaged above \$1.20 per ounce and the men received a daily bonus of \$1.25, making the wage and bonus total \$4.75 for loaders and \$5.25 for machine-runners. Now, however, with silver having declined to around \$1 per ounce the bonus would, according to the agreement, be reduced to 75c. The decision of the companies to continue to pay the higher rate is to relieve anxiety as regards the high cost of living, and to encourage miners to remain at their jobs. The \$1.25 bonus is guaranteed for at least six months, according to notices being posted at the mines.



ARIZONA

Tucson.—The engineering department of the University of Arizona has received sundry equipment, the gift of interested companies. The United Verde Copper Co. recently donated the following: One 6-hp. compound-wound 230-volt D. C. motor; two 3½-hp. compound-wound 230-volt D. C. motors; three 3½-hp. controllers. The John A. Roebling's Sons Co., of Trenton, N. J., builders of the Brooklyn bridge, have donated a handsome display board of electrical wires and cables of various kinds. The Inspiration Consolidated Copper Co. has given a 5-hp. D. C. motor.

Phoenix.—The Max-Delta Gold Mining Co. has purchased equipment for a 20-ton experimental mill.

CALIFORNIA

Amador County.—Sinking of the main shaft of the Central Eureka mine to a depth 150 ft. below the 3700-ft. level is progressing, and opening of a new level is to start shortly. The vein on the 3700-ft. level is showing the most uniform rich mill-ore opened for years, and monthly dividends are being disbursed. Unwatering of the Argonaut and Kennedy mines is proceeding at a good rate and will be finished earlier than originally anticipated, as it was found unnecessary to flood the property to as great a depth as first thought. However, it will be late in the fall before large-scale mining can be resumed.

Grass Valley.—The district is short about 300 miners as compared with June 1, 1919, according to careful estimates. High wages in other occupations and the summer call of the lumber-camps have drained considerable labor from the district. The North Star is now working on a reduced scale, but the Empire is managing to mine sufficient ore to keep its battery of eighty stamps in operation. —Rachel Benoit has sold three mining claims to the Grass Valley Consolidated Mining Co. The locations are quartz and known as the Modoc, Rising Sun, and Leader. The purchasers intend to operate them along with their other properties. The present wage-agreement between the miners and the operators will expire July 1 and committees appointed several weeks ago to draft a new scale are endeavoring to determine a satisfactory basis.

Shasta County.—The Shasta Zinc & Copper Co. has been organized to undertake further development of the property of the original Bully Hill Copper Mining & Smelting Co. The old smelter produced 40,000,000 lb. of copper, 2,000,000 oz. of silver, and 800,000 oz. of gold, the zinc being lost as oxide in the smoke. The Hayden-Stone and Jackling interests are joining Walter Arnstein and associates, who have had an option on the property for three years, in the new company. The metallurgical treatment has not yet been determined, but an electrolytic zinc plant in the vicinity of San Francisco bay is a possibility.

IDAHO

Boundary County.—The late spring has been advantageous to the Idaho-Continental, as it has conserved the water necessary for milling. Snow lies to a depth of two feet at the mine and to a greater depth on the hills above. No attempt to move ore will be made before July 15, when

the condition of the road is expected to become normal throughout its 26 miles between the mine and Porthill. The development of ore proceeded throughout the winter with a small crew, but since the resumption of milling the crew has been increased to 100 men in the mine and mill. The practice of the company is to operate the mill at capacity as long as water lasts, which is usually well into the fall, and in that period to accumulate a quantity of concentrate that may be hauled far into the winter.

Coeur d'Alene.—The Consolidated Interstate-Callahan company, now the Callahan Zinc-Lead Co., shipped 15,974 tons of zinc and lead-silver ore and concentrate in the quarter ended March 31. The total net value of the product was \$591,691. After deducting all operating expenses and excess-profit taxes for 1920 there was a surplus of \$260,000, out of which the quarterly dividend of \$186,651, or 50c. per share, was paid. —Arrangements are complete for continuing the development of the Chicago Boston mine, at Wallace. Operations are proceeding on the 200-ft. level, where ore has been opened by a drift for 200 ft. —Ore from the Monarch mine is said to be the highest grade, with one exception, ever shipped from that section. It is expected to assay 60% lead and 8 oz. silver. Other shipments of 60% lead ore have been made and one went 72.5% lead.

Elk City.—The orebody, struck recently in the Grangeville mine of the Gold Zone company, is said to have been penetrated for 14 ft. without reaching the foot-wall. The find was made by tunnel at a depth of 200 feet.

Mackay.—A new find is reported in the deepest level of the Empire Copper Co.'s mine. The ore is heavy sulphide, assaying about 6% copper. The vein was entered during the night shift of May 27, and on June 1 the cross-cut was still in ore. In March 1919 the Empire company employed Morton Webber as consulting engineer. A glass model was made of the 18 miles of workings. With the information gained therefrom, in addition to a thorough examination of the mine, Mr. Webber advised the directors that the property was largely exhausted of available ore above the lowest level; but that development at depth should bring satisfactory results if properly carried out. Accordingly a new shaft was sunk and two new levels, No. 9 and 10, are now being developed. The new shaft will finally connect with a raise which will be driven from the Cossack tunnel. This will give the mine an additional 900 ft. of backs. The Empire Copper Co. has to date paid about \$1,000,000 in dividends and is the largest copper producer in Idaho.

MONTANA

Butte.—The Anaconda company has opened what is regarded as a large tonnage of high-grade ore below the 3700-ft. level in the course of the sinking of the Stewart shaft, the significant feature of the development being the grade of ore at this depth. This deposit assayed up to 40% copper with a large back available if the shoot extends upward, as it is believed it does. The labor situation at Anaconda mines is not encouraging. In fact it is better in mines other than those owned by Anaconda. Considerable bitterness is manifest against the company, ore on the way to the smelter being found to contain chunks of iron, planned to disable the crushing machinery.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Albert Burch is at Bingham, Utah.
 Horace V. Winchell was at Spokane last week.
 Robert S. Lewis is at Huntington Lake, California.
 Philip D. Wilson, geologist of Warren, Arizona, is at Vancouver, B. C.
 William F. Staunton, of Los Angeles, was in San Francisco last week.
 Harry D. Quinby, recently at Red Mountain, Colorado, is here on a short visit.
 E. Hardy Smith is on his way from Korea to New York, by way of Vancouver.
 H. C. Bellinger, consulting engineer to the Chile Copper Co., is visiting Spokane.
 G. A. Swanquist has moved from Salvador, Central America, to Canon City, Colorado.
 Frank R. Wicks is at Breckenridge, Colorado, on consulting work for the Royal Tiger Mining Co.
 Orrin P. Peterson, of New York, is now with the Cia. Real del Monte y Pachuca, at Pachuca, Mexico.
 E. Hogberg, of Kamloops, B. C., is now with the Amalgamated Gold Mines, at Blewett, Washington.
 R. W. Stone, of the U. S. Geological Survey, is on his way to Miami, Arizona, where J. S. Diller is seriously ill.
 J. C. Van Orsdel, president of the Mt. McKinley Gold Placers, with offices at Seattle, has moved the office to Kantishna, Alaska.
 Gerald R. Lambert, of Salt Lake City has accepted the position of associate professor of geology at the Montana State School of Mines.
 H. J. Wasson, mining engineer, in the geological department of the Mariand Refinery Co., at Ponca City, Oklahoma, is at Riverside, Texas.
 Walter Fitch, Jr., mining contractor of Eureka, Utah, is at the Prince Consolidated property at Pioche, inspecting work being done there.
 Benton Leggat, general manager for the Argyle Silver Mining Co. at Basin, Montana, has returned to Salt Lake City after a visit to the property.
 Solon Spiro, president of the Silver King Con. M. Co., at Park City, Utah, underwent a severe operation in New York on May 29. He is reported as improving.
 Morton Weber, consulting engineer for the Empire Copper Co., is at the mines of the company at Mackay, Idaho. He will return to New York at the end of June.
 E. P. Mathewson has been appointed consulting metallurgist to the Granby Con. M. S. & P. Co., and H. S. Munroe has been appointed manager to take the place of R. F. M. Silvester, who has retired.

Obituary

William Lancaster, inspector of mines for the Kootenay district, British Columbia, was instantly killed in an automobile accident on May 29.

Edmund Gybbon Spilsbury, mining and metallurgical engineer of international reputation, died suddenly of heart failure on May 28, 1920, in New York after the operation for cataract had been performed upon his eyes a few days previous. He was president of the American Institute of Mining Engineers in 1896 and of the Engineers Club of New York in 1916 and 1917. He was also a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Mining and

Metallurgy, in Great Britain, the Mining and Metallurgical Society of America, the American Electrochemical Society, and the Rocky Mountain Club of New York. As the representative of one or another of the national engineering societies, he was a trustee of United Engineering Society from 1916 until his death; a member of Engineering Societies Library Board from its organization in 1913 until 1920, being its chairman from 1918 to January 1920; and a member of the Engineering Foundation Board from 1916 until his death. He was also a member of the Division of Engineering of the National Research Council. In all these societies and boards, he was an active and useful member, serving on numerous committees and contributing freely of his time and ability.

Born in London, England, in 1845, he attended school at Liège, Belgium, whither he went at an early age. His technical education was gained at the University of Louvain, in Belgium, where he was graduated in 1862. After leaving the University, he had a practical course at Clausthal, Germany. He came to the United States in 1870. His practice as a consulting mining engineer and metallurgist took him into many parts of Europe, Africa, the United States, Mexico, and South America. During the winter and early spring of 1920, he spent a number of weeks in Brazil on a mining project for clients in the United States and had returned to New York only a few weeks before his decease.

In 1864 he entered the service of the Eschweiler Zinc Co., at Stolberg, one of the largest miners and smelters of lead and zinc in the world, as assistant engineer; in 1865 he took charge of that company's mines and works on the island of Sardinia; from Sardinia he went to the Atlas mountains, in Morocco. In 1867 he entered the service of McClean & Stilman, of London, and had charge of the construction of the iron gates for the Surrey Commercial Docks; in 1868 he was designing engineer with J. Casper Harkort and had charge of most of the detail work of the Keulenbergh bridge in Holland and the Danube bridge in Vienna, also the Rhine bridge at Dusseldorf. In 1870 he was again with the Eschweiler Corphalic Co. as chief engineer. In 1870 he was sent by the Austro-Belgian Metallurgical Co. to investigate the resources of the United States in lead and zinc. After spending two years in this work, he resigned in order to practise in the United States, where he was the first to introduce the Harz system of ore-dressing for the zinc ores of Pennsylvania and New Jersey. During this period he was engaged in explorations also, on the northern shores of Lake Superior and in Colorado, Montana, Utah, and California.

In 1883 he became general manager of the Haile gold mine in South Carolina, and in 1887 he was engaged by Cooper, Hewitt & Co., of New York, and was managing director of the Trenton Iron Co., New Jersey, from 1888 to 1897. While manager of these works, he introduced as specialties of their business the Elliot locked-wire rope and the Bleichert system of aerial tramways.

In 1893 he presided over the sessions of the mining division of the International Engineering Congress at Chicago. He was the author of a number of important technical papers, among which may be mentioned 'Gold Mining in South Carolina', 1883; 'Chlorination of Gold-Bearing Sulphides', 1887; 'Improvements in Mining and Metallurgical Appliances During the Last Decade', 1897; 'Improvement in the Cyanide Process', 1910. In a lighter vein he wrote entertainingly. To the 'Mining and Scientific Press', in 1915, he contributed 'Technical Reminiscences'. Paragraphs from this narrative recall early interesting experiences and the notable progress in mining engineering during his half-century of active practice.

He is survived by three sons, Raymond G., Percifor G., and Hugh G., and by one daughter, Miss Beulah G., and a sister, Miss Matilda Spilsbury.—A. D. F.

THE METAL MARKET



METAL PRICES

San Francisco, June 8

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10
Copper, electrolytic, cents per pound.....	19
Lead, pig, cents per pound.....	8.75-9.75
Platinum, pure, per ounce.....	\$95
Platinum, 10% iridium, per ounce.....	\$130
Quicksilver, per flask of 75 lb.....	\$90
Spelter, cents per pound.....	9.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

June 7.—Copper is dull but steady. Lead is inactive but firm. Zinc is quiet and a little stronger.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York	London	Average week ending	Cents	Pence
June 1.....	99.50	57.62	Apr. 26.....	117.67	69.08
" 2.....	99.62	57.00	May 3.....	112.08	65.14
" 3.....	99.25	56.75	" 10.....	105.50	62.39
" 4.....	98.87	56.87	" 17.....	101.21	58.50
" 5.....	97.87	56.50	" 24.....	100.12	58.52
" 6 Sunday.....			" 31.....	101.17	58.87
" 7.....	94.25	54.37	June 7.....	98.23	56.52
Monthly averages					
Jan.	1918 101.19	1920 132.77	July	1918 99.62	1920 106.36
Feb.	85.79	101.12	Aug.	100.31	111.35
Mch.	88.11	101.12	Sept.	101.12	113.92
Apr.	95.35	101.12	Oct.	101.12	119.10
May	99.50	107.23	Nov.	101.12	127.57
June	99.50	110.50	Dec.	101.12	131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending	Cents	Pence
June 1.....	Apr. 26.....	19.00	19.21
" 2.....	May 3.....	19.00	19.25
" 3.....	" 10.....	19.00	19.12
" 4.....	" 17.....	19.00	19.00
" 5.....	" 24.....	19.00	19.00
" 6 Sunday.....	" 31.....	19.00	19.00
" 7.....	June 7.....	19.00	19.00
Monthly averages			
Jan.	1918 23.50	1919 20.48	1920 19.25
Feb.	23.50	17.24	19.05
Mch.	23.50	15.05	18.49
Apr.	23.50	15.23	19.23
May	23.50	15.91	19.05
June	23.50	17.53	19.05

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending	Cents	Pence
June 1.....	Apr. 26.....	8.50	8.77
" 2.....	May 3.....	8.65	8.75
" 3.....	" 10.....	8.70	8.62
" 4.....	" 17.....	8.75	8.50
" 5.....	" 24.....	8.75	8.50
" 6 Sunday.....	" 31.....	8.75	8.50
" 7.....	June 7.....	8.75	8.68
Monthly averages			
Jan.	1918 8.85	1919 5.60	1920 8.65
Feb.	7.07	5.13	5.88
Mch.	7.26	5.24	5.92
Apr.	6.89	5.05	5.78
May	6.88	5.04	5.55
June	7.59	5.32	5.55

MONEY AND EXCHANGE

Foreign quotations on June 8 are as follows:

Sterling, dollars: Cable	3.91%
Demand	3.92%
France, cents: Cable	7.77
Demand	7.77
Lire, cents: Demand	5.97
Marks, cents	2.65

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending	Cents	Pence
June 1.....	Apr. 26.....	8.05	8.37
" 2.....	May 3.....	8.05	8.32
" 3.....	" 10.....	8.05	8.21
" 4.....	" 17.....	7.95	8.11
" 5.....	" 24.....	7.97	7.96
" 6 Sunday.....	" 31.....	7.97	7.92
" 7.....	June 7.....	8.05	8.02
Monthly averages			
Jan.	1918 7.78	1919 7.44	1920 9.56
Feb.	7.87	6.71	9.15
Mch.	7.87	6.53	8.93
Apr.	7.04	6.49	8.76
May	7.92	6.43	8.07
June	7.92	6.91	8.07

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	Average week ending	Dollars	Cents
May 11.....	Apr. 26.....	85.00	80.00
" 18.....	May 3.....	85.00	80.00
Monthly averages			
Jan.	1918 128.06	1919 103.75	1920 89.00
Feb.	118.00	90.00	81.00
Mch.	112.00	72.80	87.00
Apr.	115.00	73.12	100.00
May	110.00	84.80	87.00
June	112.00	84.40	87.00

MARKET PRICE OF SILVER DROPS TO 84c.

As we go to press the market price of silver in New York has dropped to 84c. per ounce in spite of the provisions of the Pittman Act. Information available is to the effect that a question has been raised by the Treasury officials as to the form of certificate prescribed for corporations or individuals offering silver for sale at the Mint. One phase of the question is the difficulty of positively identifying silver that has been in process at smelters and refineries for months, as having come from mines in the United States. It is hoped and expected that representations can be made to the Government officials that will adjust the difficulty, and permit the sale of all domestic silver at the rate of \$1 per ounce as provided in the Pittman Act. The following form shows the affidavits, concerning which question has arisen.

Certificate in Connection with Sale of Silver to Director of Mint

State of
County of
In order to make a sale of silver to the Director of the Mint, in accordance with the provisions of the Pittman Act, approved April 24, 1918, the undersigned hereby represents and certifies, under oath, that he is the Manager of the owner of said silver, that said silver to the amount of fine ounces, delivered to the United States Mint at San Francisco, California, this day of 1920, for sale to the Director of the Mint under said Act, was produced in the United States at the (here insert name and location of mine, and dates); and was the product of reduction works situated in and that no part of said silver was mined outside of the United States of America or at any time treated by reduction works or refineries located outside of the United States.

(Signature of vendor or duly authorized officer.)
Subscribed to and sworn to before me this day of 1920.
Notary Public.

State of
County of
The undersigned, being duly sworn, deposes and says that he has read the foregoing affidavit of dated 1920, and is the of owner of the mine described in said affidavit; and that the silver described in said affidavit, in the amount of fine ounces, was produced in the United States at the said (insert name and location of mine, and dates).

(Signature of owner of mine or duly authorized officer.)
Subscribed to and sworn to before me this day of 1920.
Notary Public.

State of
County of
The undersigned, being duly sworn, deposes and says that he has read the foregoing affidavit of dated 1920, and is the manager of the owner of the reduction works described in said affidavit; and that the silver described in said affidavit, in the amount of fine ounces, was the product of said reduction works situated in in the United States, and not the product of any reduction works located outside of the United States.

(Signature of owner of reduction works or duly authorized officer.)
Subscribed to and sworn to before me this day of 1920.
Notary Public.

Eastern Metal Market

New York, June 2.

A gradual improvement in the country-wide transportation conditions is apparent here and there in some of the markets, but the holiday recess from May 29 to 31 has interfered with any possible resumption of activity.

The copper market is inactive and firm, with demand light.

The tin market has been quiet with a recession in prices.

The lead situation is unchanged and prices are firm with a premium obtainable for spot delivery, New York.

There is still no life to the zinc market but prices are fairly steady.

Prices for antimony are lower.

IRON AND STEEL

Pig-iron production figures wired to 'The Iron Age' from all districts on the first day of June show a total for May of 2,988,881 gross tons. This is an average of 96,415 tons per day and compares with a total of 2,739,797 tons in April, or 91,327 tons per day. Thus there was a recovery of about 5000 tons per day from the slump in April to 17,000 tons per day below the March rate.

It is still the outstanding fact in the industry that output is best nearer the raw material end. While shipments of finished steel are again slightly better this week, the Pennsylvania Railroad leading in the improvement, pig-iron is picking up faster. Furnaces in blast on June 1 numbered 295, against 281 on May 1, and 312 on April 1. Resumption of a number of blast-furnaces is planned for the coming week.

A rapid return to normal railroad operation is now expected and as soon as adequate stores of fuel are collected an expansion of iron and steel-plant activity will ensue, following increased activity in the week in rolling-mills.

COPPER

This market is marking time. The acknowledged improvement in the transportation situation is having its effect in better supplies to refineries and in a more regular movement of finished material, but there is still no buying of consequence. Confidence is strong that a buying movement will set in soon since the technical phase of the market is strong in that production has been curtailed lately over 50% and stocks have declined. Against this, however, must be set the fact that melting by consumers has also lessened. But buying of copper appears in waves and as the last one was about two months ago it is figured that another is due soon. Producers generally are still maintaining their quotations at 19c., New York, for both electrolytic and Lake copper for June, and 19.25c. for July and perhaps August in some cases. In the outside market, which is decidedly limited as to scope, prices vary from 18.25 to 18.75c. for June. As to exports, it is probable that they were less in May than in any month this year. Inquiries from foreign sources are, however, good.

TIN

The market continues quiet, due partly to the holiday, but more largely to the fact that consumers appear to be discouraged with no ambition to buy. This is not strange in view of low prices. Tin fell last week to the lowest price in many months when it sold at 50c., New York, for spot Straits on May 27. The price has hovered around this level and up to 52c. since. Yesterday spot Straits was quoted at 51.50c., New York. Dealers also show a reluctance to buy and so transactions the past week have been light as compared with previous ones. The total for all positions and all grades, as made on the New York Metal Exchange, has been less than 150 tons at prices ranging from 49c. for

June delivery to 50.50c. for July delivery. Late last Thursday there was a fair demand for Eastern-shipment metal, mostly from dealers, at 50.75 to 51.25c. The London market was quoted at £287 5s. for spot Straits yesterday against £289 per ton a week ago. Arrivals of tin for May were 6230 tons, of which only 350 tons came in at Pacific ports. Deliveries of the metal into consumption in May were 3550 tons, with 5356 tons in stocks and landing on May 31. Total imports to June 1 were 23,013 tons against 6341 tons to June 1, 1919. Of the imports this year 18,420 tons has come from the Straits Settlements.

LEAD

The only point of interest in this quiet market is that spot lead, New York, is still available at 9.37½c., at which price also sales again have been made. But there is no urgent demand for it and buyers have lost more if not all of their anxiety. Deliveries are better from the West, indicating the gradual improvement in transportation. We quote the outside market unchanged at 8.15c., St. Louis, or 8.50c., New York, with that of the leading interest at 8.25c., St. Louis, and 8.50c., New York.

ZINC

The market continues devoid of any features. The most that can be said is that prices have not fallen further. Demand is very light, neither consumers nor sellers showing any interest in early delivery nor in futures. The London market was higher yesterday, and so was sterling exchange, which caused a slight advance in the price over last week. We quote prime Western for delivery in the next two months at 7.70c., St. Louis, and 8.05c., New York, with about 7.75c., St. Louis, and 8.10c., New York, asked for third quarter. The holiday recess has also been a factor here as in this and other markets.

ANTIMONY

This market is duller and lower. Wholesale lots of the lower grades for early delivery are quoted around 8.87½c., New York, duty paid, with the better grades commanding 9c.

ALUMINUM

The market is unchanged with the leading producer asking 33c., New York, for virgin metal, 98 to 99% pure, in wholesale lots for early delivery and other sellers quoting 31.50c.

ORES

Tungsten: There has been no change and the market is still inactive with prices largely nominal at \$6.50 to \$15 per unit, depending on the grade and the delivery. Not much is expected until the tariff matter is settled.

Ferro-tungsten is quoted at 85c. to \$1.15 per lb. of contained metal in the alloy or the powder.

Molybdenum: This market is dead and quotations are nominal at 75c. per lb. of MoS₃ in regular concentrate.

Manganese: There is a good demand for the ore at prices from 80c. to \$1 per unit, but not much is publicly offered.

Manganese-Iron Alloys: Quotations are unchanged and firm at \$250, delivered, for June and \$200 for last half, at which a few transactions are reported. The slackness in steel output has relieved the tension and accounts for the present quietness. There are now four companies making ferro-manganese in electric furnaces, the Anaconda company, the Southern Manganese Corporation, the Tennessee Manganese Co., and the Ferroalloy Co., Denver. Output from all sources in May was the largest for any month this year or over 24,500 tons. The spiegeleisen output was over 12,500 tons in May, or the second largest for the year. The quotation is firm at \$75, furnace, and 300 tons has been sold to an Eastern consumer.

Company Reports

TONOPAH BELMONT DEVELOPMENT CO.

Report for the year ended December 31, 1919.

Property: mines and mill at Tonopah, Nevada, and interests in properties elsewhere.

Operating Officials: Frederick Bradshaw, general manager; L. R. Robins, mine superintendent; W. H. Royston, mill superintendent.

Financial Statement: value of production, \$1,231,482; net value of bullion, \$1,124,857; operating expense, \$742,861. Net earnings at Tonopah, \$381,995. Income from Belmont Surf Inlet mines, \$204,352. Net profit, \$569,807.

Dividends: during 1919, \$375,000; to date, \$10,043,063.

Development: 5282 ft. of work was done. The assured reserves amount to 112,133 tons as against 82,798 tons one year earlier.

Production: during the year the mill treated 133,332 dry tons of ore, of an average metal content of 0.141 oz. gold and 13.54 oz. silver and an average per-ton value of \$17.889. The aggregate metal content of the ore was 18,834 oz. of gold and 1,804,951 oz. of silver, and the total money value was \$2,385,248. There was recovered as bullion 16,960 oz. of gold and 1,533,042 oz. of silver, and in concentrates and by-products, 857 oz. of gold and 117,627 oz. of silver.

UNITED EASTERN MINING CO.

Report for the year ended December 31, 1919.

Property: mines and mill at Oatman, Arizona.

Operating Officials: J. A. Burgess, general manager; W. O. North, assistant general manager; D. B. Boalen, mine-foreman; Earl M. Bagley, mill-foreman.

Financial Statement: gross value of ore milled, \$2,031,594; loss in tailing, \$61,085; recovery, \$1,970,509; operating cost, \$883,836; net income from operations, \$1,073,935. Current assets on December 31, \$826,666.

Dividends: during 1919, \$899,580; total to date, \$2,153,540.

Development: work for the year amounted to 3730 ft. at the United Eastern and 350 ft. at the Big Jim mine. In addition to this 769 ft. of raising was done to furnish ventilation and passes for stope-filling. Drifting on the seventh level has exposed the main ore-shoot for a continuous length of 750 ft. and the face of the south drift, which is now being driven, shows ore of milling grade 7 ft. wide. Development work is being extended laterally. The estimate of assured ore-reserves as of January 1, 1920, is 269,207 tons having a gross value of \$6,000,820 and an average of \$22.29 per ton, as compared with estimate of assured ore-reserves as of January 1, 1919, of 265,363 tons having a gross value of \$6,467,005.

Production: 97,325 tons of ore was milled; 91,264 oz. of gold and 55,974 oz. of silver were recovered. Value of ore per ton, \$20.87; average price of silver, \$1.13.

BUTTE & SUPERIOR MINING CO.

Report for the year ending December 31, 1919.

Property: mine and mill at Butte, Montana.

Operating Officials: Charles Bocking, general manager; E. V. Daveler, general superintendent; Angus McLeod, mine superintendent.

Financial Statement: operating revenue, \$5,912,640; less freight, \$1,051,471; net, \$4,861,169. Operating costs, \$3,944,897; net income plus depletion, \$916,272. Balance on December 31, 1918, \$5,698,654; paid in settlement of Elm Orlu litigation, \$2,719,778. Surplus on December 31, 1919, \$3,062,121.

Dividends: none during 1919; total to date, \$16,940,258.

Development: there was performed during the year, 11,879 ft. of drifting, 6448 ft. of cross-cutting, 2699 ft. of

raises and winzes, and 43 ft. of stations, or a total of 21,069 ft., exclusive of 1793 ft. of diamond-drilling. The estimate of ore-reserves as of December 31, 1919, shows 623,300 tons averaging 16.7% zinc and 5.7 oz. silver as compared with the estimate of 830,000 tons at December 31, 1918, averaging 17% zinc and 5.7 oz. silver. The decrease is accounted for partly by the consent decree in apex litigation with the owners of the Elm Orlu claim, whereby a considerable tonnage of developed ore was lost.

Production: the total ore milled for the year was 403,436 tons, of an average grade of 14.698% zinc and 6.25 oz. silver. The mill recovery for the year averaged 95.528% of the zinc contents. The direct milling cost for the year was \$2.74 per ton, as compared with \$2.92 for the preceding year, a decrease of 18c. per ton. The zinc concentrate contained 2,521,414 oz. of silver, 10,874,039 lb. of lead, and 118,591,220 lb. of zinc, and the lead concentrate contained 42,293 oz. of silver, 1,587,018 lb. of lead, and 329,853 lb. of zinc.

TONOPAH EXTENSION MINING CO.

Report for the fiscal year ended March 31, 1920.

Property: mines and mill at Tonopah, Nevada.

Operating Official: John G. Kirchen, general manager.

Financial Statement: net income from sale of bullion, \$1,056,754. Cost of mining, \$385,898; cost of milling, \$280,702; other costs, \$74,797. Net income, \$346,653. Current assets, \$1,061,196.

Dividends: during fiscal year, \$321,178; total to date, \$2,361,379.

Development: 5941 ft. of work was done during the year in addition to 595 ft. of diamond-drilling. Several branches of the Murray vein, which were good producers on the 1680-ft. level, remain to be developed on this level. Preparations have been made to sink the Victor shaft 150 ft. deeper and establish a level at the 1880-ft. point. Due to the shortage of miners, this work was not undertaken.

Production: there was mined during the year 70,611 tons of ore, all of which was treated. The gold and silver content of this ore was as follows: 858,411 oz. silver, an average of 12.157 per ton; 8180 oz. gold, an average of 0.116 oz. per ton. These figures show a decrease, as compared with last year, of 0.661 oz. of silver and 0.005 oz. of gold per ton. The average price received for silver was \$1.1744 per ounce, and \$20.6718 per ounce for gold, making the average gross value of the ore mined and milled \$16.676 per ton, of which \$14.278 was silver and \$2.398 was gold.

BUNKER HILL & SULLIVAN MINING & CONCENTRATING CO.

Report for the year ended December 31, 1919.

Property: mines, mills, and smelter at Kellogg, Idaho.

Operating Officials: Stanly A. Easton, manager; R. S. Handy, mill superintendent; M. H. Sullivan, smelter superintendent.

Financial Statement: gross lead and silver value of product shipped, \$4,990,731; dividends from Caledonia and Sierra Nevada companies, \$234,065. Total operating profit, \$1,888,559. Depletion and depreciation charged off, \$1,630,042.

Dividends: during 1919, \$1,144,500; total to date, \$23,803,500.

Development: conditions made the usual development impossible during the year; but the moderate amount of such work conducted on No. 15 level, the bottom level of the mine, was extraordinarily successful. The extension of the mine workings in the Stemwinder and Sullivan mines has also exposed additional ore.

Production: 393,698 tons of ore was concentrated, in addition to 86,925 tons of tailing; 80,002,268 lb. of lead and 1,375,657 oz. of silver were produced from the mine.

Book Reviews

Mechanical Drafting Manual. By Charles B. Howe. Part I. General Principles of Drafting and Working-Drawings. Part II. Geometry of Drawing. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, 50 cents each.

These are evidently for use in the class-room or elsewhere in connection with the author's 'Mechanical Drafting'. They could hardly be used to advantage in any other way. Each 'Part' consists of a heavy envelope containing about fifteen 6 by 8 in. sheets, upon each of which are directions and sketches for the performance of a particular lesson in the subjects indicated by the titles above. This particular form is unusual for an instruction course, but there are certain evident advantages.

Topographic Maps and Sketch Mapping. By J. K. Finch. Pp. 170, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, \$2.50.

Interest in maps, and particularly topographic maps, has been stimulated, like interest in so many other subjects, by the War. The treatment in the present volume is non-technical and can be followed readily by the layman who has only the most elementary knowledge of mathematics. The book will be useful principally to two general classes of readers; first, men and women that use topographic maps but who do not know how to get the maximum benefit from them, and second, students engaged in learning to make a map that will be of maximum benefit to the user. The book is therefore appropriately divided into two main parts, Map Reading, and Sketch Mapping, besides a short additional chapter on Landscape Sketching. The discussion of map reading covers three chapters entitled, respectively, What a Topographic Map Shows, How to Get Certain Information from a Map, and Use of Topographic Maps in the Field. Part II, on Sketch Mapping, is similarly divided into Topographic Drafting, Flat Mapping, and Contour Mapping. The appendix contains a descriptive list of the principal topographic maps of the world, suggestions for a course in map reading and sketch mapping, and a bibliography, the first of the three divisions being particularly valuable.

Prospector's Field-Book and Guide. By H. S. Osborn. Ninth edition, revised and enlarged by M. W. von Bernewitz. Pp. 364, ill., index. Henry Carey Baird & Co., New York. For sale by 'Mining and Scientific Press'. Price, \$3.

Mr. von Bernewitz has drawn largely on his diversified experience in New Zealand, Australia, and the United States in his revision of this work. The introduction contains many hints for prospectors and others interested in mining. There are 16 chapters devoted to preparatory instruction, the blow-pipe, crystallography, surveying, analysis of ores, gold, silver, platinum, copper, lead, zinc, antimony, iron, chromium, manganese, molybdenum, titanium, tungsten, uranium, vanadium, tin, mercury, bismuth, nickel, cobalt, cadmium, aluminum, petroleum, asphalt, oil shale, ozokerite, various useful minerals, abrasives, gem stones, useful rocks, and weights and measures. Much new material has been included, among the noteworthy additions being lists of equipment for a prospecting outfit, data on field-tests, notes on sampling, an explanation of the unit system of selling ore, an entirely new section on alloy minerals, and numerous new illustrations. The chapter on oil has been expanded and the discussion of oil-shale is a new feature. The index and glossary are exceptionally practical. Aside from the information which the prospector in the field may find in the volume there is material of value to the engineer, and others interested in mining from a practical or a technical stand-

point. The book is of pocket size and has a flexible cover which adds to its convenience.

The New Industrial Unrest. By Ray Stannard Baker. Pp. 231. Doubleday, Page & Co., Garden City, New York. For sale by 'Mining and Scientific Press'. Price, \$2.

The author of this book is well known to the reader of popular magazines because of his articles on both industrial and political matters. He approaches the field of industry from the standpoint of an outside investigator, but, nevertheless, an investigator who is honestly desirous of learning the truth and of being fair to both sides. The first few chapters are devoted mainly to the steel strike. While admitting the excellence of the welfare work done by the U. S. Steel Corporation, and the sincerity and good intentions of the officials both before and during the strike, he holds that the Corporation is an industrial autocracy, and considers Judge Gary as typical of the ultra-conservative employer. Both employers and workingmen he divides into three general classes: conservatives, moderates, and radicals, and considers that the moderates in both groups are still in the majority. He discusses various solutions offered by the two sides for the problem of unrest, and places his own approval on some form of works-council system. In particular he discusses the application of this system to the men's clothing industry. Considerable space is also devoted to employment management as a means of helping in obtaining better industrial relations. In the endeavor to be timely and up to date, the author has perhaps erred on the side of too hasty composition, but the book will be read with profit by many people that could not be induced to look at some of the more scholarly studies of industrial relations.

Recent Publications

Our Mineral Supplies. H. D. McCaskey and E. F. Burdard. Bull. 666, U. S. Geological Survey, 1919. Pp. 278.

Gold, Silver, Copper, Lead, and Zinc in Arizona in 1918—Mines Report. By V. C. Heikes. I:15, U. S. Geological Survey, 1920. Pp. 40. From Mineral Resources of the United States, 1918—Part I.

Gas in the Big Sand Draw Anticline, Fremont County, Wyoming. By A. J. Collier. Bull. 711-E, U. S. Geological Survey, 1920. Pp. 9, map. From Contributions to Economic Geology, 1919—Part II.

Deposits of Manganese Ore in Arizona. By E. L. Jones, Jr., and F. L. Ransome. Bull. 710-D, U. S. Geological Survey, 1920. Pp. 184, ill., maps. From Contributions to Economic Geology, 1919—Part I.

Abram Creek-Stony River Coal Field, Northeastern West Virginia. By George H. Ashley. Bull. 711-F, U. S. Geological Survey, 1920. Pp. 19, diagram, map. From Contributions to Economic Geology, 1919—Part II.

Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1918—Mines Report. By Charles W. Henderson. I:14, U. S. Geological Survey, 1920. Pp. 26. From Mineral Resources of the United States, 1918—Part I.

Paleontological Correlation of the Fredericksburg and Washita Formations in North Texas. By W. S. Adkins and W. M. Winton. University of Texas Bulletin No. 1945, 1919. Pp. 128, ill., index. Published by the University of Texas, Austin, Texas.

Pliocene and Pleistocene Fossils from the Arctic Coast of Alaska and the Auriferous Beaches of Nome, Norton Sound, Alaska. By William H. Dall. Professional Paper, 125-C, U. S. Geological Survey, 1920. Pp. 37, ill. From Shorter Contributions to General Geology, 1919.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

'FROM THE MINING OF THE ORE TO THE FINISHED PRODUCT'

The completion by the Anaconda Copper Mining Co. in 1918 of a rod and wire-drawing mill at Great Falls, Montana, marks a new departure in the industry in that the company now manufactures the copper that it produces into copper wire, strand, trolley-wire, and rolled-copper rods. The addition of this final step to the long process of mining, concentrating, smelting, and refining, is of great advantage to the users of the products, for the direct supervision from the mining of the ore to the finished product, assures a product of unvarying high quality.

The ore mined at Butte, containing about 3% copper, is first enriched to 8% by concentration. The fine concentrate

are made. The finished cathode is 38 by 30.5 in. and weighs 130 lb.; 160 tanks of cathodes are drawn daily and 40 tanks of anodes are changed each day.

The slime contains approximately 12,000 oz. silver and 75 oz. gold per ton. The following is a typical analysis of the electrolyte in the refining tanks.

	Gm. per litre
Free acid	180.0
Copper	43.0
Arsenic	7.0
Antimony	0.5
Chlorine	0.035

The electrolyte has an average specific gravity of 1.235; its purity is maintained by running off daily to the purifica-



The Anaconda Company's Plant at Great Falls

is then roasted to remove 80% of its sulphur, and is then smelted in reverberatory furnaces; the coarser ore goes to the blast-furnaces. The reverberatory and blast-furnaces produce matte, (40 to 50% copper), and slag as a waste product. The matte is treated in converters which deliver an impure copper. The last stage is reached in the refining furnaces which turn out commercially pure copper, which is cast in the shape of anodes and shipped to Great Falls, Montana, and Perth Amboy, New Jersey. The anodes contain approximately 70 oz. silver and 0.25 oz. gold per ton.

The new electrolytic copper-refinery at Great Falls, which began operation in March 1918, contains 1020 refining tanks, 60 of which are devoted to the production of starting sheets. The tanks are divided into eight sections of 120 each, and are arranged in cascades of five. A separate electrolyte is maintained for each section, and it is pumped by means of air-lifts. The anodes used are of the lug type, 36.5 in. long and 28 in. wide. They are handled by means of a narrow-gauge railway. These cars are moved into the tank-house where the crane transfers 25 anodes at a time from the car to the refining tank. Each tank contains 25 anodes and 26 cathodes. The anodes remain in the tank 24 days during which time four drawings of six-day cathodes

tion plant a sufficient amount of solution to prevent building up. In the purification plant, the solution is concentrated by boiling to 48°B. and run to crystallizing tanks, where about 8% of the copper is recovered as bluestone; the remainder is drawn off and treated in anode-tanks for the removal of the remainder of the copper and the arsenic, antimony, and bismuth. The outlet solution from these tanks is further concentrated by boiling to 56°B. After cooling the iron, nickel, lime, and magnesia are precipitated as basic salts. The bluestone is re-dissolved and returned to the tank-room.

The copper as it comes from the electrolytic refinery is nearly pure but before being shipped to the consumer must be melted and cast into shapes suitable for rolling mills or manufacturers of brass and other alloys. This part of the process is carried out in the furnace refinery. The furnace refinery is equipped with two reverberatory copper-refining furnaces, each with capacity for melting 400,000 lb. of copper day. Each furnace is provided with a casting wheel, mold-presses, and other necessary apparatus for economical handling of the product.

The cathodes are delivered to the furnace-refinery on industrial cars, each car carrying four piles of cathodes, the

load weighing about eight tons. When a furnace is to be charged the three large charging doors on the side of the furnace are opened. The charging crane is brought into position in front of the furnace. The long arm on the crane picks a pile of cathodes from the car, thrusts it into the furnace and deposits it. It requires three hours to bring the furnace up to a melting temperature which is from 1100° to 1300°C. About eight hours after the furnace has reached this temperature the charge has all been melted and is free from the furnace-bottom. The slag that has formed, consisting mostly of copper oxide, is now skimmed off, leaving the bath clean.

The refining process is designed to get rid of the absorbed gases in order that physically sound castings may be made. In order to bring this about iron pipes are thrust into the bath of molten metal, through which air is blown. The oxygen of the air unites with the copper, forming cuprous oxide in the presence of which the gas ceases to be soluble in the metal and is expelled. It is rarely necessary to carry the oxidation beyond this point. In this process the impurities contained in the metal are oxidized, and hydrogen, carbon monoxide, and sulphur compounds are driven off.

After oxidation has been completed large wooden poles are thrust into the metal bath and held down beneath the surface of the metal. The dry distillation of the wood tends to reduce the cuprous oxide with which the bath of metal is now saturated. This operation is continued until the oxygen has been reduced to about 0.060%. At this point the polling is discontinued and the slag is skimmed. The bath is now covered with charcoal, and the polling resumed. The polling operation causes agitation of the metal, bringing all of the metal in contact with the charcoal covering the bath. When the copper contains from 0.010 to 0.025% oxygen, it is ready to cast.

The tap hole, launders, and ladles have by this time been made ready for tapping. The wall of refractory material at the tap-hole is cut away, and the metal overflows and passes through a Y-shaped launder into the ladles, of which there are two for each machine. The casting wheel itself is 40 ft. in diameter.

As the molds move around the circle they are sprayed both from above and below to promote cooling and after they have passed half-way round the circle are automatically dumped, allowing the castings to fall into a bosh filled with water. It is this chilling in water that gives the castings or shapes their characteristic red color. The metal when ready for shipment has the following approximate analysis:

	%
Copper	99.96
Oxygen	0.03
Silver	0.0022
Bismuth	0.0004
Sulphur	0.002
Iron	0.0006
Cobalt and nickel	0.0006
Arsenic	0.0017
Antimony	0.0016
Selenium	0.0009

Slag from furnace operation is re-smelted either in the blast-furnaces or converters. The building for the rolling mills is 450 ft. long by 125 ft. wide and is constructed of steel, brick, and glass. The rod mill consists of an 18-in. roughing mill; intermediate mill, finishing mill, bar-heating furnace, coilers, roll-lathe for grooving the rolls, and other accessory apparatus necessary to make the mill complete. The wire-drawing machinery, consisting of a 4-block bench for drawing large sizes of wire in coils; a continuous trolley-wire drawing-bench with its reel-stand; one 10-die and one 9-die continuous, double block, wire-drawing machine for drawing No. 12 and smaller sizes of wire, in coils or on reels; two 6-die and one 5-die double block machines for

drawing wire from No. 6 to No. 12, and three single-die machines for drawing medium hard wire. The annealing equipment consists of one double chamber non-oxidizing annealing furnace and one open-fire furnace. The stranding equipment consists of four stranding machines of different capacities. All of these machines are served by a 5-ton traveling crane, which covers the full width of the building and runs its entire length.

It is interesting to note that the products of the rolling-mills department are the first of their kind to be manufactured west of the Mississippi. Previous to the erection of this plant, the wire bars from the furnace-refinery were all shipped to mills in the East and Middle West. When wire and strand were required for the power-development projects in the West it had to be shipped back.

LINK-BELT 'LETTGO' MECHANICAL OVERLOAD-RELEASE

An effective safety-first device that will instantly disengage a drive when the load exceeds a predetermined point, has been developed by the Link-Belt Co. It is known as the 'Lettgo' mechanical overload-release. It is especially adaptable for elevating, conveying, and power-transmission machinery. The 'Lettgo' will automatically disengage the driving from the driven machinery if the load exceeds the fixed amount, thus allowing the driving motor or other source of power to run free and prevent damage, due to the inertia of the motor armature or other high-speed moving parts.

The construction of this device is such that it will release whether the load is gradually or suddenly applied, but it can be set so that it will not trip from jars or shocks. The device is symmetrical, and can be assembled to operate in either direction. It can be adjusted for tension, so that it will operate for any desired overload. The mechanism is entirely enclosed and can be packed with grease for lubrication purposes. Being positive in its action and easily reset, the Link-Belt 'Lettgo' has distinct advantages over other devices designed to accomplish the same result.

COMMERCIAL PARAGRAPHS

The report of the trustees of the pension fund of the Fairbanks-Morse Co., for 1919 shows eight members pensioned, death benefits of \$11,675, and net resources of \$505,000 practically all invested in high-grade bonds. The fund was established on January 1, 1917, and at the close of 1919 had 1139 contributing members.

The folder entitled 'Recent Notable Achievements', which was included in the annual stockholders' report of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., tells about the work of the company in supplying electric locomotives to the Chicago, Milwaukee & St. Paul railroad; the electric equipment of the battleship 'Tennessee', and other naval vessels; and the 70,000-kw. steam-turbine in the 74th Street station of the Interborough Rapid Transit Co. Some of the large steam-turbine plants now in progress of construction are listed.

The Worthington Pump & Machinery Corporation, 115 Broadway, New York, announces to the engineering profession and to the trade that, in addition to the well-known lines of hydraulic machinery which it has manufactured since 1840, it has now completed preparations to furnish improved waterpower machinery of all capacities for low, medium, and high-head service, including oil-pressure systems, water-wheel governors, and other auxiliaries. It is entering this field equipped to produce hydraulic turbines to meet the highest standards in design, efficiency, and workmanship. To supplement its experienced staff, familiar with hydraulic problems, it has secured the services of competent designers having many years of successful experience. The hydraulic-turbine department is prepared to receive inquiries, which will be given prompt and careful attention.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 120 Market St., San Francisco,
by the Dwyer Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JUNE 19, 1920

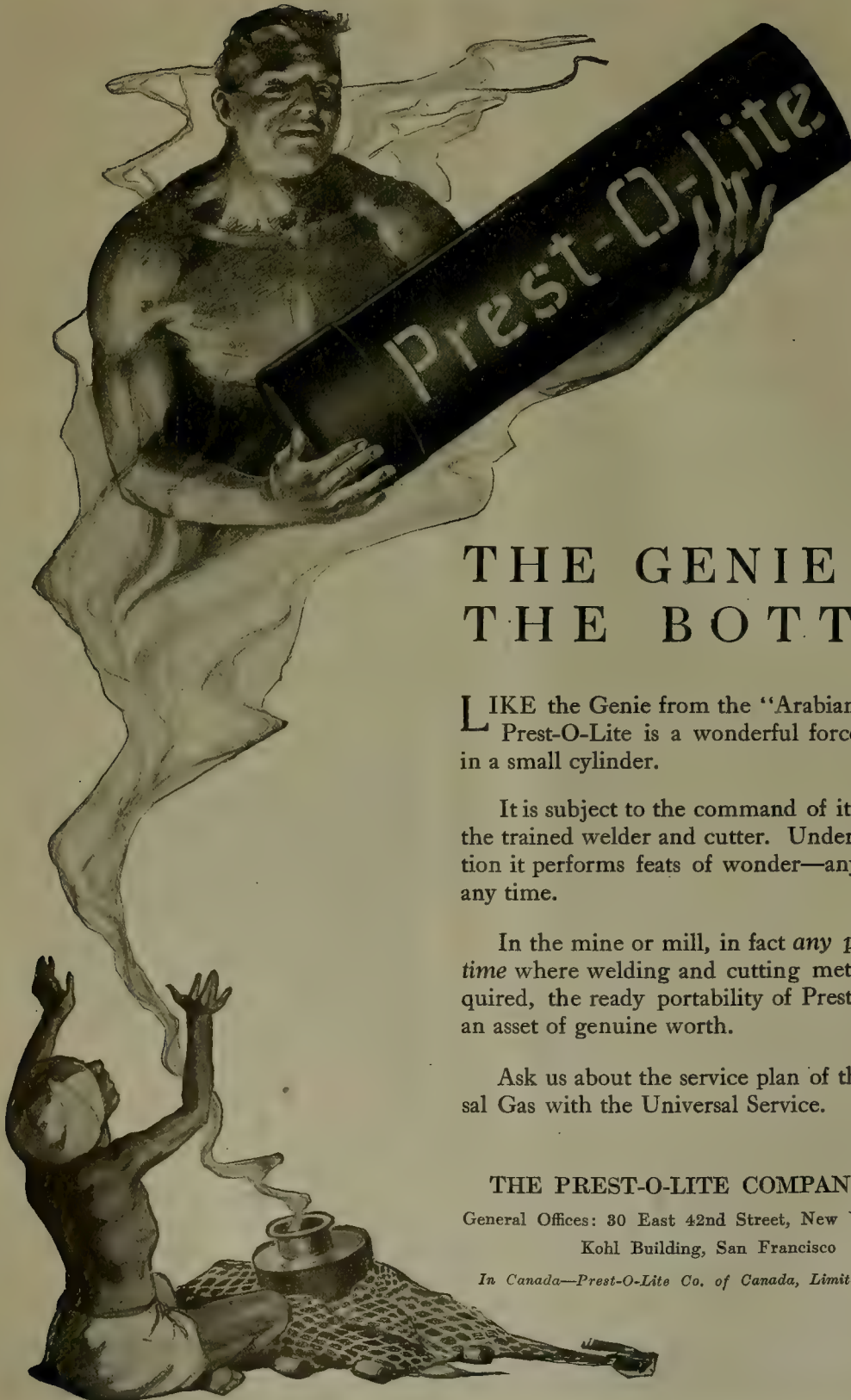
\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

	Page	Page
EDITORIAL		
NOTES	889	graph in the study of detonation. The action when a number are connected in series. Practical conclusions.
THE SUPPLY OF OIL.....	890	THE DORR BOWL-CLASSIFIER
Report of the Federal Trade Commission. Views of the directors of the U. S. Bureau of Mines and Geological Survey. Suggestion from Mr. Lane. British oil holdings as compared with American. Our control of the preponderating proportion. The need for assisting American enterprise abroad.		By Henry Hanson
THE COLLAPSE OF SILVER	890	905
Arrangements by Director of the Mint to comply with Pittman Act. The affidavits required from shippers of bullion to prove its domestic origin. Purchases by the Mint to continue. The position of the smelters and means taken to overcome complications.		A combination of the hydraulic cone, the mechanical classifier, and the Dorr thickener. Utilization of backflow. Advantages of the new device.
MR. SULMAN AND MINERALS SEPARATION.....	891	SOME FEATURES OF THE GEOLOGICAL DEPARTMENT OF THE ANACONDA COPPER MINING COMPANY
Article in the 'Mining Magazine', of London, by Mr. Sulman. Reply to his defence. Our criticism of the bestowal of the medal by the Institution of Mining and Metallurgy. It was untimely and inappropriate. Discovery of the froth-agitation process. Mr. Sulman's treatise of 1906 and his recent paper. Affidavit by T. J. Hoover.		By Paul Billingsley
		907
		Organization of the department. Co-operation. Promptness. Accuracy. Immediate translation of geological results to mine operation. Records made.
		MINERALS SEPARATION V. MIAMI COPPER COMPANY
		909
		Affidavit of Theodore J. Hoover relating to a treatise on flotation prepared by Messrs. Sulman and Picard in 1906. Affidavit of William Sidney Stevens relating to the use of centrifugal pumps as agitators in the flotation process.
		PROCEEDINGS AGAINST MINERALS SEPARATION BEFORE THE FEDERAL TRADE COMMISSION
		911
		Testimony of Henry I. Foster, formerly investigator for the Federal Trade Commission. Letters from prospective licensees. Refreshingly frank letters from E. H. Nutter, the company's chief engineer. Royalties too high, he thinks. Why the American company was organized.
		NOTES
		PROPOSED CODE OF ETHICS
		901
		DEPARTMENTS
THE MEASUREMENT OF VENTILATING AIR		REVIEW OF MINING
By Walter S. Weeks.....	895	913
The anemometer; its calibration. The Pitot tube. Measurement of pressure. Determination of average velocity. The manometer. A problem solved.		THE MINING SUMMARY
A STUDY OF ELECTRIC DETONATORS		921
By Carl T. Long and Hubert L. Pascoe.....	902	PERSONAL
Construction of detonators. Use of the oscillo-		922
		METAL MARKET
		923
		EASTERN METAL MARKET
		924

Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.



THE GENIE OF THE BOTTLE

LIKE the Genie from the "Arabian Nights", Prest-O-Lite is a wonderful force confined in a small cylinder.

It is subject to the command of its master—the trained welder and cutter. Under his direction it performs feats of wonder—anywhere, at any time.

In the mine or mill, in fact *any place*—any time where welding and cutting metals are required, the ready portability of Prest-O-Lite is an asset of genuine worth.

Ask us about the service plan of the Universal Gas with the Universal Service.

THE PREST-O-LITE COMPANY, Inc.

General Offices: 30 East 42nd Street, New York, N. Y.

Kohl Building, San Francisco

In Canada—Prest-O-Lite Co. of Canada, Limited, Toronto



T. A. RICKARD, . . . Editor

THE American Institute of Mining and Metallurgical Engineers will meet from August 20 to September 3 in the Lake Superior region. Sessions will be held at Iron Mountain and Hibbing.

MINE-FOREMEN and shift-bosses are disinclined to take kindly to direction from young and inexperienced mining-school men. On the other hand, many of these young graduates over-estimate their own wisdom and fail to give due consideration to the practical man who may know more about his own mine than he can well put into words. In an article on another page Mr. Paul Billingsley describes the relations between the staff of young geologists in the employ of the Anaconda Copper Mining Company and the superintendents and foremen of the 25 mines operated by the company in Montana. According to his idea, a reasonable amount of "humbleness in spirit" in the attitude of young geologists is one of the chief factors in promoting co-operation. Other features of the work of the geological department are emphasized by Mr. Billingsley in an interesting way.

A GENIUS from Hanford, California, the father of "over thirty inventions, one of which has been patented", announces the perfection of a set of "scientific, accurate, and practical instruments" that should make prospecting not only definitely successful, but delightfully easy and comfortable, and unattended with the hardships usually experienced by the seeker for nature's hidden treasure. In apprising the "interested public" of its good fortune in having available his services and instruments, the inventor makes this startling assertion: "That they will locate or indicate the whereabouts of a mineral or ore vein, and buried treasure, while riding at full speed in an auto, and that distance does not seem to make any difference in their locating power. I have tested some of my instruments for a distance of over 350 miles." We marvel at the velocity, but we can readily accept the statement in so far as it describes the uniformity of results. In these days of gloom, it is pleasant to contemplate anything cheerful, even a cheerful liar. Taking the inventor's own conservative figures, there are alluring possibilities in a range of operation circumscribed by a 350-mile radius. The would-be mine-owner could prospect the entire Rocky Mountain region in the course of a fortnight without ever emerging from the

comfortable corner of a pullman car. Here is a further assurance: "I have perfected separate instruments to locate the following minerals: gold, silver, copper, lead, galena, magnesite, molybdenum, chromite, zinc, nickel, cinnabar, tungsten, platinum, and oil." The presence in the list of a 'galena detector' as well as a device for lead reminds one of the farmer who, after the cat had kittens, cut a small hole in the floor of the corn-crib, beside the large one by which the mother was wont to enter. Unfortunately, "Germany is the only country that will patent mineral instruments, hence I do not sell or loan these instruments, but only locate with them upon the following terms". For "locating a mineral vein or lode" these terms are "\$15 per day plus traveling expenses, and half of what is located". However, special rates will be arranged when more than one location is made for a single client, so that a sizable enterprise can avail itself of the services of this scientific prospector without pledging 50% of its future production. This seems only fair. The gentleman belongs to a genus with which we can claim some acquaintance already. There be those who can diagnose the geology of a region by aid of a telescope; there are others who can appraise a mine from a specimen of ore; there are scribes who can write articles on mining districts without going to them and give wordy accounts of processes without seeing them in operation; the world is full of fakers, a word that must not be confused with 'fakir'. A 'faker' is one who makes or contrives; it is a good Anglo-Saxon word. 'Fakir' is Arabic for poor man and designates the mendicants or religious beggars of the East. Some of these fiscal agents, as they are called in the vernacular of today, are something of both; they concoct, they beg, and they almost make a religion of the art of deception.

THIS year the Republication nomination for the presidency is of more than usual significance because every well-informed person knows that the nomination is very nearly equivalent to election. Viewing the nomination made at Chicago from a non-partisan standpoint we confess that we would have preferred the ticket to be Coolidge and Harding; but this is a great year for the political machine; it ironed out the Hoover campaign in California and it went over the Chicago convention with a result that is decidedly flat. Under the circumstances it is fortunate that a politician so respectable and acceptable as the senator from Ohio should have been nomi-

nated. He belongs to the same class as McKinley. Two men, at least, of real intellectual power were set aside deliberately; we refer to Mr. Herbert Hoover and Mr. Nicholas Murray Butler; but they are not politicians, and to be President one must be a politician as well as a statesman. That is the consequence of our system of selection. Moreover, the presidency is not only an administrative but also a political office; the President is the head of the dominant party, and his co-operation with Congress is essential to the efficiency of the Government. Unusual gifts of mind, without the political sense, have brought disaster to the present holder of the office. The clash of interests and the conflict of ideas in a republic such as ours call for sympathy as well as imagination, for understanding as well as knowledge. The Democratic opportunity is larger than it seemed before June 12, but it is unlikely that it will overcome the disability of being identified with the outgoing Administration.

The Supply of Oil

We note that the Federal Trade Commission has investigated this subject, at the request of Congress, and has issued a report that seems to us to be just and reasonable. The Commission concludes that the increase in the price of petroleum products is due rather "to varying conditions of supply and demand in the light of emphasized and pessimistic statements as to a future supply than to a combination in restraint of trade". Healthy competitive conditions still obtain in the oil industry, it is said. The recent advance is due primarily to interruption in transportation, as well as to the increase in consumption. On the whole, the Commission considers that "the psychological factors in the situation were more important than the actual statistical condition, the mental attitude of the oil trade being strongly affected on the one hand by the frequent statement that there was an impending decline of production in the United States, which was aggravated by the sudden slump of North Texas output in the middle of 1919, and by the unfavorable development industrially and politically in Mexico in the autumn of that year". To this state of mind the addresses and other published statements of the directors of the U. S. Bureau of Mines and Geological Survey have contributed largely, for both of these authorities have struck a note of panic in regard to the proximate exhaustion of our domestic oil resources. The Commission makes two sensible suggestions, the first is to encourage American enterprise in the production of oil in foreign countries, and the second is to restrict the exportation of our own oil. Here it is only right to note that Mr. Franklin K. Lane, in his annual report as Secretary of the Interior, stated that "the encouragement of, and effective assistance to, our nationals in developing foreign fields is essential to securing the oil needed". In this connection we submit that it is ridiculous to criticize the British for developing oil resources abroad, when, in the first place, the British dominions have only 2½% of the world's production of petroleum, while we have 70% of

it in our own country, besides the control of 12% more, in Mexico, Rumania, and South America. Let us emulate their enterprise and 'go after' the oil that is obtainable in countries willing to permit our nationals to exploit their resources, and let it be the business of the Administration at Washington to support and protect our nationals in their legitimate enterprise abroad. Next, it is absurd to exclaim against the high price of oil while we allow the domestic market to be depleted by exportation to foreign countries. On this phase of the subject the politicians are silent because they are afraid to tread on the corns of what are called the big interests, but it is manifest insincerity to assist Irish propaganda by attacking the legitimate enterprise of the British while we are so careless about our domestic supply as to allow it to go to Australia and to other British dominions. During the month of April there was exported through the port of San Francisco 40,267,230 gallons of oil valued at \$2,556,208, of which 867,628 gallons, worth \$273,413, was gasoline. It matters much less who produces the oil than who receives it, that is, into which market it goes. If Americans produce oil in Burma and it goes to London, it helps us no more than it helps the British if a British company produces oil in California and sells it in San Francisco or New York. Let us keep our own production for our own use and then let us go abroad to obtain the further supply that we may need. In any event, we do not suppose for a moment that gasoline derived from petroleum will be the motor-spirit of ten years hence; by that time we shall be using some derivative from coal or some form of alcohol. Besides, we have tremendous resources in our oil-shale deposits. Meanwhile let us adopt a straightforward enterprising policy worthy of a great pioneering people and go into the waste places of the earth for all the oil or other mineral products that we may need, not sit around belly-aching about the self-interested explorations of other people.

The Collapse of Silver

On our financial page last week we recorded the fact that the price of silver on the open market in New York had declined to 84 cents; at the same time we printed the form of a three-fold affidavit that the Director of the Mint requires from the vendor, from the mine-owner or producer, and from the manager of the reduction plant at which was refined the silver in any bullion offered for sale at the Mint. Consignments of bullion accompanied by this affidavit, duly acknowledged, have at no time been declined by the officials of the Mint, but, on the contrary, have been accepted and paid for at \$1 per ounce in accordance with the provisions of the Pittman Act. Unless the Act be repealed this will continue to be done until at least 207 millions shall have been purchased. On the other hand, producers of silver-bearing ore have found that in their settlements with the smelters the New York quotation, which, as stated, touched 84 cents on June 8, has governed, in accord with the contracts under which the ore was sold. Many have been unable to reconcile these apparently conflicting prices and have felt

that they were not being fairly treated. The explanation is not difficult. Under the terms of the Pittman Act, the silver purchased at \$1 must be the product both of mines situated in the United States and of reduction works or refineries so situated, and clear and unequivocal proof to this effect must be supplied. As will appear from a perusal of the form of the affidavits, which we printed last week, this proof must be furnished for each individual lot or consignment of bullion presented for purchase at the Mint. Clearly this would require identification and segregation of silver by custom smelters and refineries that would be entirely impracticable in view of the customary practice of combining various lots of ore, concentrate, or base bullion for treatment. In respect of ores already in process this would be physically impossible. The smelters therefore were only protecting themselves when they settled at the market, or New York, price rather than at \$1, until such time as an understanding could be reached with the Federal officials. They have proposed that the Government agree to purchase at the fixed price a quantity of silver equivalent to the amount that can be proved to have been recovered from ores mined and treated exclusively in this country, without demanding the identification of the actual metal as having originated within our boundaries. The remainder, coming from Canada, Mexico, or elsewhere, the smelters or refiners, of course, will have to sell in the open market. On the recommendation of Mr. Raymond T. Baker, Director of the Mint, the Treasury department has, we believe quite properly, acquiesced in this arrangement, and the legal authorities have advised that it is in accord with the law, so that hereafter any company mining silver in the United States is entitled to a settlement on a basis of the fixed price, \$1 per ounce, from the smelter to whom it consigns its ore, subject, of course, to the usual terms of its contract, and providing the affidavit as to origin is made. Certain changes in the form and sequence of the affidavits are under consideration. These, however, are simply for greater convenience and simplicity; they will have no essential effect on the settlement. It is important to note that the position of those mining companies whose immediate output is sold to the Government in the form of bullion is not in any way affected, so long as no part of the content of such bullion comes from outside the United States. As we have pointed out before, the only requirement is that the combined gold and silver content of their product amounts to 200 parts in 1000. The Mint does not purchase bullion containing more than 800 parts of base metal, but the proportion of gold as compared with silver is immaterial. The Director, however, may specify delivery at New York, Philadelphia, Denver, or San Francisco, at his option. The domestic output of silver last year was 55 million ounces, so that at the present rate of production four years will be required to supply the 207 million ounces that already has been ordered to be purchased by the Director of the Mint. Should the market price reach \$1, purchases under the Pittman Act would cease automatically for the time being, so that

there is a probability of this four-year period being increased measurably. It will be recalled that under the authority of the Act the Treasury actually melted and sold 271 million dollars to supply the foreign demand, principally from India and China. This need has now apparently been satisfied; at the same time the melting of silver coins in France, Germany, and other countries in continental Europe and the recent monthly production of about \$6,000,000 in Mexico have been factors operating toward the collapse of the price in the open market. The Government is not suffering any loss in making purchases at a price above the market, because an equivalent amount was melted and sold at \$1 per ounce plus all costs incident to the transaction.

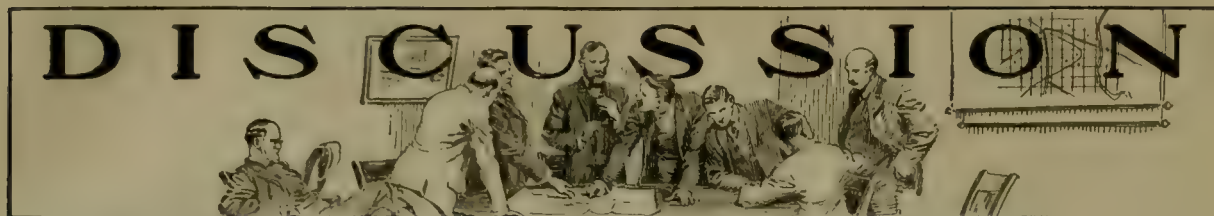
Mr. Sulman and Minerals Separation

The May issue of 'The Mining Magazine', of London, contains an editorial entitled 'The Attack on Mr. H. L. Sulman', and on another page there appears a letter from Mr. Sulman himself. The front page of the same issue of 'The Mining Magazine' is devoted to an advertisement of the Minerals Separation company, but the coincidence should suggest a lack of the sense of humor rather than a sinister inference. The editorial is an echo of Mr. Sulman's letter and calls for no comment, except its lame attempt to establish an analogy between Dr. F. G. Cottrell's gift of his fume patent to the United States government and Mr. Sulman's sale of his flotation patents to the Minerals Separation company. The mere statement suffices to expose the absurdity of the comparison. Mr. Sulman's letter calls for a reply, as it is directed in large part against the criticisms appearing in these columns. Before starting to answer him, we record the fact that on May 25 Mr. Ballot filed a copy of Mr. Sulman's letter, as published in 'The Mining Magazine', with the U. S. Circuit Court of Appeals for the Third District, before which the case of Miami Copper Co. v. Minerals Separation Ltd. is now being re-heard. To come to Mr. Sulman: he says that attacks have been made upon him by "a small section of the American technical press". He is mistaken; the criticism has come from all the technical papers interested in metallurgical matters. He charges our technical press with an improper motive, namely, the creation of a hostile opinion designed to prejudice the trial of the suits brought by Minerals Separation in the United States. This is buncombe. Speaking for ourselves, we have ventilated the subject, not of Mr. Sulman alone but of the doings of his company in the United States, because it was one of immediate interest to our readers, that is, to those engaged in mining and milling. We have a strong conviction that froth-flotation was not discovered by Mr. Sulman or by the Minerals Separation people but by technicians in the Central mill at Broken Hill in 1904, namely, Messrs. F. A. Beauchamp and Wilton Shellshear, under the direction of Mr. James Hebbard, the manager of the Central mine. We base this conviction on statements made to us personally by Messrs. Beauchamp and Shellshear, and by

the published statement of Mr. Hebbard in the Proceedings of the Australasian Institute of Mining Engineers. In December, 1904, says Mr. Hebbard, tests in the Central mill, using only 0.75%, that is, less than 1%, of oil, gave results that were "excellent, with all float-concentrate, no granular material being formed". The "granular" refers to the fact that the discovery of the efficacy of a minute proportion of oil came gradually, in the course of experiments started in 1901, in which the Cattermole sinking process was superseded finally by the flotation method. We have quoted this statement of Mr. Hebbard's repeatedly, because it proves to us, and to any detached onlooker, that the 'discovery' claimed to have been made by Messrs. Sulman, Picard, and Ballot in March, 1905, is fictitious. Apart from the correspondence between Broken Hill and London, it may be recorded that Mr. G. A. Chapman went from the Central mill to the Minerals Separation office in London in the last days of 1904.

We have opposed the exactions of Minerals Separation because we believe that the company is not entitled to a monopoly of the process and also because their methods have been extortionate, unfair, and prejudicial to metallurgic progress. They tried unsuccessfully to prevent us from publishing technical information on the flotation process, as already recorded in these columns. Our answer was the publication of two books on the subject within the following three years. Mr. Sulman tries to distinguish between the American company and the parent company. He says that his holding in the American company is only a tenth of 1%, but even that is a 'critical' proportion, having regard to the amount of tribute collected and to be collected. Moreover, the evidence given recently before the Federal Trade Commission shows that the parent company holds all but 7% of the shares in the American company. Whatever Mr. Sulman's shareholding may be, as the principal patentee and as metallurgist to Minerals Separation, he is identified with that company, to whose affairs he has devoted his energies since the company was first organized. As to the "pothor" about his paper, he asks the cause of it. We answer. The reason why his paper has drawn so much attention is, in the first place, that it was given as the reason for awarding him the gold medal of the Institution of Mining and Metallurgy. This was done at a time when the American mining industry was resenting bitterly the demands and impositions of a patent-exploiting agency with which his name is identified. Mr. Sulman, of course, is not known in this country outside his connection with the Minerals Separation company. In his paper he drew attention to that connection by going out of his way to compliment the chairman of the company, Mr. John Ballot, who is more particularly identified with the unpleasant business methods of Minerals Separation. The award of the medal to Mr. Sulman was a slap in the face of the American mining public. The gentlemen who made the award did not realize this fact, because, as yet, Minerals Separation has not made itself so thoroughly disliked by British mining companies as it has by the American. Flotation as a process is not nearly

as important to the British mining engineer as to the American; the one important mining centre where froth-agitation is used on a large scale is Broken Hill, and there it has to compete with two or three other flotation processes, so that relief is available. It all depends whose ox is being gored. Mr. Sulman objects to the adjective 'belated' as applied to his paper, which was read before the Institution and served as the pleasant excuse for awarding the gold medal to him. He suggests that we called it "slovenly in presentment", when, on the contrary, we went out of our way to compliment him on the clarity and evident care with which it was written. But it was not only "belated", it was resurrected. The original treatise was written in 1906, thirteen years before he read his recent brochure. A copy of the "typed booklet", as he calls his original and elaborate treatise of 1906, is now in the hands of the Circuit Court of Appeals at Philadelphia, where it serves as evidence to show that the Minerals Separation company has construed its basic patent in a manner not in accord with the interpretation of the patentees, Messrs. Sulman and Picard, as recorded by them in 1906, three years before patent No. 835,120 was assigned to Minerals Separation. The "atmosphere of mystery and suspicion", as Mr. Sulman describes it, was created neither by Sir Thomas Rose's remark nor by Mr. T. J. Hoover's reference, but by our knowledge of the fact that Mr. Sulman did write a comprehensive treatise in 1906, that a copy of it was in California, and that his recent be-medalled paper was largely a rehash of it, with such excisions and alterations as would adapt it to the exigencies of pending litigation. On another page we publish the affidavit of Mr. Theodore J. Hoover as filed at Philadelphia. Mr. Sulman asks: "I would inquire by what law, ethical, legal, or sentimental, I am required to keep the world informed in print of the progress of my views". This is a nice piece of rhetorical confectionery, but it is beside the mark. Our point is that the Institution has set the stamp of its approval upon secrecy in the arts, it has honored a metallurgist who kept back valuable information for 13 years, and who was associated with men that made it their business to stifle the publication of technical information essential to progress in the art of metallurgy. When, at last, he publishes his moth-eaten views on the subject, he is applauded and rewarded by the greatest distinction within the gift of the Institution, and the secretary of the Institution emphasizes the fact by specifically informing the press that the award is the very highest in its gift. Some of our friends in London have written to say that they thought us ungenerous in our criticisms of Mr. Sulman. We have no grudge against Mr. Sulman, but we hate humbug and we resent the apparent endorsement of Minerals Separation, through Mr. Sulman, all the more as he, in his paper, went out of his way, not to dissociate himself from Mr. Ballot's policy, but to tender him a highly perfumed bouquet. If the medal had been given to Mr. Sulman at any other time or for any other reason, it would not have concerned us; but given at this time and for such reasons as those stated, we protest unhesitatingly.



Some Observations on Smelting

The Editor:

Sir—Being confronted with a problem in the disposal of copper concentrates and ores, and smelting having been sadly neglected during my technical education and training, it became urgently necessary for me to make good the delinquency. Therefore, I collected all the available reading-matter on the subject, such as books, bulletins, pamphlets, papers, and articles, and being a lone white man in a remote corner of the world, I had ample time during the long winter evenings to peruse and thoroughly digest them.

I found the reading-matter most entertaining and must congratulate the smelting-men on having compiled a mass of such interesting and, at the same time, informative literature. But, while reading, I noted an idea that prevailed so persistently as to almost amount to an obsession; the idea being the paramount importance of concentration, and the contempt of the experts for any process that yielded low concentration was indeed ill concealed. For example, E. D. Peters in his classic treatise on the 'Practice of Copper Smelting' passes lightly over the highly interesting pyritic process at Tilt Cove, Newfoundland, as being hardly worthy of attention from real smelting-men, because the concentration was only two into one, and the same attitude is apparent throughout.

Consequently, during my course of study, the question continually occurred to me, "Has not froth-flotation entirely revolutionized the art of smelting?" or, in other words, "Does it really pay to eliminate worthless earthy gangue-material from copper ores by a complicated process working at 1300°C. when the same thing can be done better by a simple process working at 13°C.?" I use "really" and "earthy" advisedly. If this question can be answered in the negative, then the Tilt Cove process with its 2:1 concentration, its simplicity, and its entire lack of costly extraneous fuel, becomes the process, and all others (with some exceptions) become back numbers. The exceptions are those plants treating ores in which the gangue is predominantly sulphide of iron; because froth-flotation is not a pronounced success when it comes to separating one sulphide from another, and even if it could not compete with a process that on a diet of mere wind, flavored with a little coke, treats lump ore direct from the mine.

Of course the smelter-men will exclaim, "Yes, but your ideas are all awry, because our present methods will not permit flotation concentrate to be smelted according to Tilt Cove practice"; and from what I have read I

must admit that this appears to be so. But is it absolutely impossible to change the methods?

With clean silicious copper sulphide ores, a froth-flotation plant should recover 95% of the copper, in a concentrate assaying from 20 to 25% copper. Such a concentrate by simple melting will produce a matte going 25 to 30% copper, and by afore-mentioned books and bulletins tell me that such a matte is suitable for converting in the modern basic-lined converter. Therefore it appears likely that smelting will drop its 's' and become plain melting, that is, melting flotation concentrate so that it can be poured into a converter and blown to 'blister'. Of course, the flotation concentrate will contain some earthy substances, which will have to be removed during the melting operation, but I shall come to these later.

Coming now to the matter of generating heat for the melting operation. In my smelting literature, especially the more recent publications, I see many references to pulverized coal for conventional reverberatories and also blast-furnaces. On reading of this pulverized fuel, the thought crossed my mind, "Why, what about flotation concentrates as a pulverized fuel?" As produced, it is approximately the same degree of fineness as pulverized coal—80 to 90% through 200-mesh, and a large proportion practically impalpable powder (probably several thousand mesh)—so that its physical properties are all in order. Now what about its thermo-chemical properties? The following problem will elucidate the point: A flotation concentrate containing 20% copper as chalcopryite and 15% quartz gangue (for simplicity), the rest being pyrite, is to be burned as a pulverized fuel. The 'ash' is to be a 50% copper matte and a corresponding ferrous silicate slag. What is the calorific value of the fuel? With the help of our faithful friend and guide, Richards' 'Metallurgical calculations', I solved this problem and obtained as result:

Calorific value = 1280 B.t.u. per pound.

The equation shows that 16 cu. ft. of air is required per pound of fuel, hence the calorific value of the fuel-air mixture is 80 B.t.u. per cubic foot—easily comparable with the calorific value of the gas-air mixture used for firing open-hearth steel-furnaces. I am fully aware that there are some vital differences in the processes of combustion of these two fuels, but this is a matter of mechanical arrangement and detail. The same calculation brings out some interesting points: it shows that the ash constitutes 82% by weight of the fuel burned—a vital point of difference between this fuel and ordinary pulverized fuels, where the ash usually amounts to less than

20%. Fully 40% of the fuel goes into the ash as matte, and 42% as slag. The slag lies between a 'uni' and a 'sesqui' silicate, therefore it should be quite satisfactory, and as the weight of the slag and of matte is approximately equal, the slag can run much higher in copper than usual without causing losses of any moment. Further calculations show that the theoretical temperature attainable, using cold air and cold fuel, is 1436°C.; while, if the air be pre-heated to 300°C. and the fuel to 200°C., the theoretical temperature becomes 1648°C.; and as there is practically no limit to the rate at which the furnace could be driven, the actual temperature should approach very near to these theoretical temperatures. Taking actual data from an operating blast-furnace plant, Richards shows that the theoretical temperature is 1569°C., so it is safe to assume that this hypothetical furnace burning concentrate as pulverized fuel could be maintained at a temperature sufficiently high to conduct the smelting operation without extraneous fuel, and at the same time have sufficient heat to spare to melt a little miscellaneous lump material that might happen to be about the premises. However, to tide the process over the rough spots, the judicious use of a little electric current might be advisable, especially in districts where water-power is available. As the annual production of electric steel will approach the 1,000,000-ton mark when the world settles down to work again, the application of electric energy to metallurgical furnaces can be said to be well past the experimental stage, so there is nothing particularly outrageous in the above suggestion.

This is not 'pyritic' smelting; it is much better than that. My books and bulletins tell me that in the pyritic process somewhat less than half the sulphur is available for fuel and matte-formation, the rest actually extracting heat from the furnace by being volatilized. While in the above suggested smelting scheme, the whole of the sulphur (other than that required for the matte) instantaneously flashes into SO_2 , in the same manner that the carbon of the pulverized coal flashes into CO_2 . Incidentally, one of the most interesting possibilities is the enormous capacity per unit-volume such a furnace would have. This is where the new pulverized fuel will differ most from the old. The present metallurgist prides himself on the smallness of the weight of fuel he can burn in a given volume (*vide* the large coal-dust fired reverberatories), but the future metallurgist will take special pride in the smallness of the volume in which he can burn a given weight of fuel.

So here in flotation concentrates we have a valuable pulverized fuel, which is being produced in enormous quantities, and which the mines would be pleased to deliver to the smelters gratis, free, and for nothing. In this connection, during my course of reading, I frequently came across something that seemed to me to be extraordinary. It appears that at many plants today wealth is being dissipated by destroying a perfectly good pulverized fuel by a process of slow combustion (roasting), then further wealth is being dissipated by burning another valuable pulverized fuel (coal) in the propor-

tion of 1:6, in order to melt the 'ashes' from the first perfectly good pulverized fuel. This would appear to be nothing less than rank bolshevism, and as such I commend it to the serious attention of the officials of the U. S. Department of Justice now on the trail of the Reds.

After making some further calculations to make sure that my theory was all in order, I started to make an experiment. My equipment consisted of a miscellaneous assortment of crucibles, piping, tubing, valves, ejectors, montejus, combustion-tubes, a wind-furnace, and compressed air. My material was an ordinary flotation concentrate containing 22% copper and 18% earthy gangue.

After burning numerous holes in a perfectly good suit of clothes, and making a genuine Stetson look as if it were in the throes of an attack of black small-pox, I succeeded in burning my pulverized fuel so as to yield an intense heat and leave an ash consisting of a 47% copper matte, and a satisfactory slag. The process was not self-sustaining thermally, but this was only to be expected considering the voracious appetite of small furnaces for heat. The dust and fume losses did not appear to be excessive; but, in any case, dust and fume have lost most of their terrors since the perfecting of the Cottrell process.

In view of these results and my unbounded faith in the ability of the men who were responsible for the literature I have been reading, with a reasonable amount of luck, I expect to live to see the day when we are going to be introduced to something new, something revolutionary, something fit to take its place beside cyanidation and froth-flotation. The pyritic process was a step in the right direction, but unfortunately, as developed, it is of limited application. The smelting problem is not solved until every mine, irrespective of locality, can have its own smelter and turn out its own blister copper. All the ingenious amalgamating devices did not solve the problem of precious-metal recovery; all the wonderful refinements in gravity concentration did not solve the base-metal concentration problem; likewise all the improvements in standard conventional practice are not going to solve the smelting problem. To reinstate the reverberatory is simply to revert to the cruder methods of a century ago.

H. H. S.

Kokai, Chosen, May 6.

ONTARIO'S production of crude petroleum was reported by J. C. Waddell, supervisor of bounties, to be 220,100 bbl. in 1919, a decline of about 68,000 bbl. from the 1918 output, due chiefly to the failing production from the Mosa Township field. The Petrolia field, now entering the fifty-eighth year of production, shows an increased output of about 4600 bbl. The Tilbury field has been divided into Tilbury East and Dover West, the latter producing 16,705 bbl. from the Trenton formation. The Union Natural Gas Co. has seven producing wells in this field, and the Petrol Oil Co. completed one in October and is now drilling another.

The Measurement of Ventilating Air

By WALTER S. WEEKS

INTRODUCTION. The quantity of ventilating air in circulation is estimated by obtaining the velocity of the air at a section of a mine-opening whose area is known, and multiplying this velocity by the area. The velocity in feet per minute multiplied by the area in square feet gives the cubic feet per minute.

The instruments in general use for determining the velocity are the anemometer and the Pitot tube.

THE ANEMOMETER is a small windmill geared to a pointer which revolves on a dial. The dial is arranged like that of a gas-meter with small dials where the hundreds, thousands, and tens of thousands are recorded. Between the wheel and the recording apparatus is a tiny clutch, or disconnecter, so that the recording mechanism can be thrown in or out at will. The instrument records the linear feet of air that pass through the vanes; for

for one minute with the clutch thrown in. It is necessary to take the velocity at a number of different points in a section of a drift because the velocity varies. It is least near the walls and greatest near the middle. If the operator holds the anemometer in his hand, his body in



FIG. 1. STANDARD TYPE OF ANEMOMETER

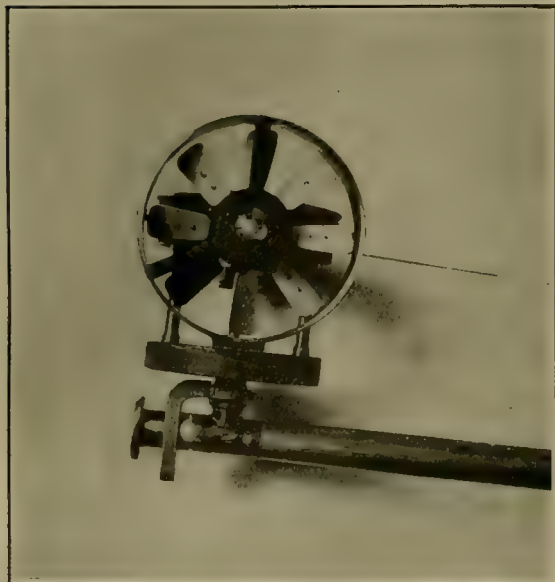


FIG. 2. ANEMOMETER MOUNTED ON A STICK



FIG. 3. HIGH-SPEED ANEMOMETER

instance, if the instrument is held in the air current for three minutes and it reads 900, the velocity is 300 ft. per minute. The favorite size of anemometer for mine use is 4 inches in diameter. They can be obtained with a mechanism by means of which all the dials can be set back to zero. This is not necessary; but it is convenient. Fig. 1 shows an anemometer of the type generally used.

To obtain the velocity of the air in a drift a point should be selected where the drift is uniform for some distance. The area at this point should be divided into sections by strings or by eye and the velocity should be obtained in each by holding the anemometer in the centre

the airway may be a sufficient obstruction to cause error in the determination.

A more accurate determination may be obtained with an anemometer mounted on a stick. Fig. 2 is an instrument of different design so arranged. The clutch is thrown in by a thread and thrown out by an elastic band. With this arrangement the operator may stand entirely out of the current when taking a reading.

The ordinary anemometer can be used for air velocities up to 2000 ft. per minute. The wheel begins to turn when the velocity is from 30 to 50 ft. For velocities below 50 ft. a special instrument must be used. For high

velocities such as are met in ventilating-pipes, an anemometer of more rugged construction is necessary. Fig. 3 is a photograph of a high-velocity anemometer which can be used up to 6000 ft. per minute.

CALIBRATION. For measuring velocities from 50 to 1200 ft. per minute the anemometer is the best instrument available, but it is usually inaccurate. It is commonly calibrated in this way: A long arm is arranged to be revolved in a horizontal plane about one end as a centre. The anemometer is mounted on the outer end with the axis of the wheel horizontal and at right angles to the arm. If the rate of rotation is known the velocity of the anemometer through the air can be calculated and the instrument thus calibrated. This method causes air currents that are not exactly comparable with straight-line flow. Again, the heavier the air the faster the wheel will turn in a current of given velocity, so the anemometer at high altitudes is liable to give low results. The slightest change in the angle of the blades will change the action. They are easily bent.

As an instrument for obtaining the absolute velocity of the air, the anemometer is poor, but as an instrument for obtaining the relative amounts of air in the mine-openings, the anemometer serves a most useful purpose.

THE PITOT TUBE. For testing ventilating-fans it is necessary to know the absolute velocity of the air. For this work a Pitot tube is used. The theory of it should be understood.

Suppose we have a small pressure-fan blowing into a pipe. We wish to measure the static pressure in the pipe where it joins the fan. It has been proved by experiment that when air is flowing with uniform velocity in the pipe, the static pressure is the same all over the pipe. In order to obtain static pressure accurately there must be no impact of the air against the opening where the measurement is taken. A pin-hole is all that is necessary to transmit static pressure, so if we take a small metal tube with one end sealed and bore a pin-hole in the side of the tube, this hole, if placed toward the side of the ventilating-pipe will transmit the static pressure accurately to the inside of the tube when the open end of the tube is connected with a water-gauge, or manometer, as it is called. The difference in level of the water in the two legs of the manometer will indicate the static pressure.

If we point the end of a small tube against the air current and connect the other end to a manometer, the manometer will record the sum of two pressures. First it will record the static pressure existing in the pipe, and secondly it will record the pressure due to the impact of the air striking against the end of the tube. If we connect the pin-hole tube to the other end of this same manometer we subtract the static pressure from the sum of the static and impact pressures and so the manometer will read only impact pressure. If we can determine the relation that exists between the impact pressure and the velocity of the air, we have a simple means of measuring velocity.

The apparatus just described is in essence the Pitot tube. In the modern Pitot, however, the static and im-

pact tubes are combined into one instrument. Fig. 4 is a section of a tube from the code of the American Society of Mechanical Engineers. *A* is the end that faces the air current and is acted upon by the static pressure and by the impact of the air. The pressure at *A* is the pressure in *G*, which is connected to one leg of the manometer. The tube *G* passes inside the tube *H*, but is connected with it in no way. *C*, *D*, *E*, and *F* are pin-holes. The pressure in *H* when connected to the manometer is the static pressure of the pipe. When *G* and *H* are connected with the two legs, the manometer records the impact pressure. We must next study the relation that exists between the impact pressure and the air velocity.

The usual explanation of the operation of the Pitot tube involves the energy equation

$$v = \sqrt{2gh}$$

and a head of water in the manometer is supposed to be held up which is equivalent to a head of gas equal to $\frac{v^2}{2g}$ which is the velocity-head of the flowing gas.

This explanation is incorrect. The problem is not one of energy, but of impact. The gases are deflected by the point of the tube and an impact pressure is produced. In Fig. 5 a stream of air is flowing along a smooth surface and is deflected by a vane *BD* through the angle *z*. What pressure does the stream exert at *B* in the direction *ABC*? In other words, what force is trying to move the vane *BD* in the direction *BC*?

The stream is flowing with a velocity of *v* feet per second along *AB*. After deflection the velocity along *BD* is, of course, the same, but the velocity in the direction *ABC* is *v* cos *z*. Let us consider a small particle of air of weight *dw*. This has its velocity changed from *v* to *v* cos *z* in the time *dt*. The deceleration in the direction *ABC* is $\frac{v - v \cos z}{dt}$

The force to change the velocity is $F = \frac{dw}{g} \left(\frac{v - v \cos z}{dt} \right)$
 $\frac{dw}{dt}$ = weight flowing per sec., or *W*; so $F = \frac{Wv}{g} (1 - \cos z)$

Let *w* = weight of 1 cu. ft. of air.

Let *a* = area of the stream.

$$W = w a v$$

$$F = \frac{w a v^2}{g} (1 - \cos z)$$

$$\frac{F}{a} = \frac{w v^2}{g} (1 - \cos z)$$

$\frac{F}{a}$ is the pressure in pounds per square foot exerted on a section at right angles to the stream.

The end of the Pitot tube deflects the air current in the same way and the pressure is produced in the same way, but the shape of the stream lines are such that different parts of the stream are deflected at different angles. The cumulative pressure, however, is such that the unit pressure on the end of the tube is $\frac{1}{2} \frac{w v^2}{g}$ with the type of tube now in use. This has been proved experimentally by calibrating the tube with a very accurate meter.* Thus,

* W. C. Rowse, 'Pitot Tubes for Gas Measurements'. Journal Am. Soc. M. E., September 1913.

while the impact pressure has the same value as the velocity pressure, there is no causal connection between the two.

MEASUREMENT OF PRESSURE. This impact pressure is measured with the water manometer when the tube is connected in the manner already described. We must now determine the relation between the velocity and this

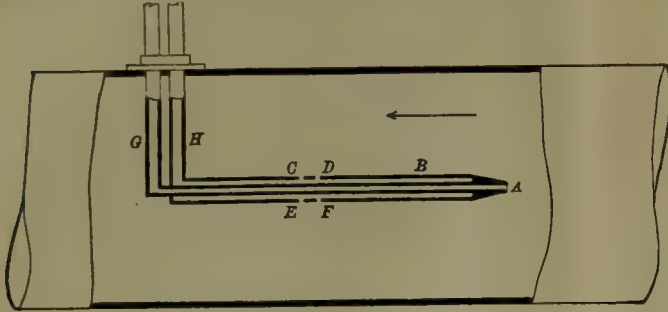


FIG. 4. SECTION OF PITOT TUBE

head of water. 60°F. will be taken as the standard temperature of water. The weight of one cubic foot of water at this temperature is 62.37 pounds.

$$\frac{w v^2}{2g} = \frac{i}{12} \times 62.37 \quad i = \text{head of water in inches.}$$

$$g = 32.174$$

$$v^2 = \frac{2i \times 32.174 \times 62.37}{w \times 12}$$

$$v = 18.29 \sqrt{\frac{i}{w}}$$

Velocity in feet per minute or

$$V = 60 \times 18.29 \sqrt{\frac{i}{w}} = 1097.4 \sqrt{\frac{i}{w}}$$

i is the reading of the manometer in inches and w is the weight of air in pounds per cubic foot.

THE WEIGHT OF AIR. The weight of a cubic foot of air depends upon its pressure, temperature, and mois-

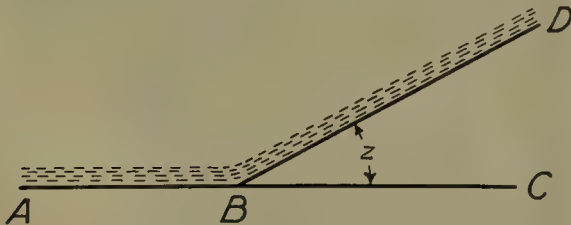


FIG. 5. SHOWING DEFLECTED STREAM

ture content; so, to determine its weight, we must have a barometer and a sling psychrometer.

A sling psychrometer is a combination of a wet-bulb and a dry-bulb thermometer that can be whirled around. Fig. 6 shows a handy type. It is whirled around by the chain. With the kind permission of the Buffalo Forge Company I am able to use the tables for determining the weight of a cubic foot of air. This table (No. 1) is from their handbook, 'Fan Engineering'. (See following page.)

An example will illustrate its use: The barometer is 29.3 in., the dry-bulb temperature is 62°F., the wet bulb

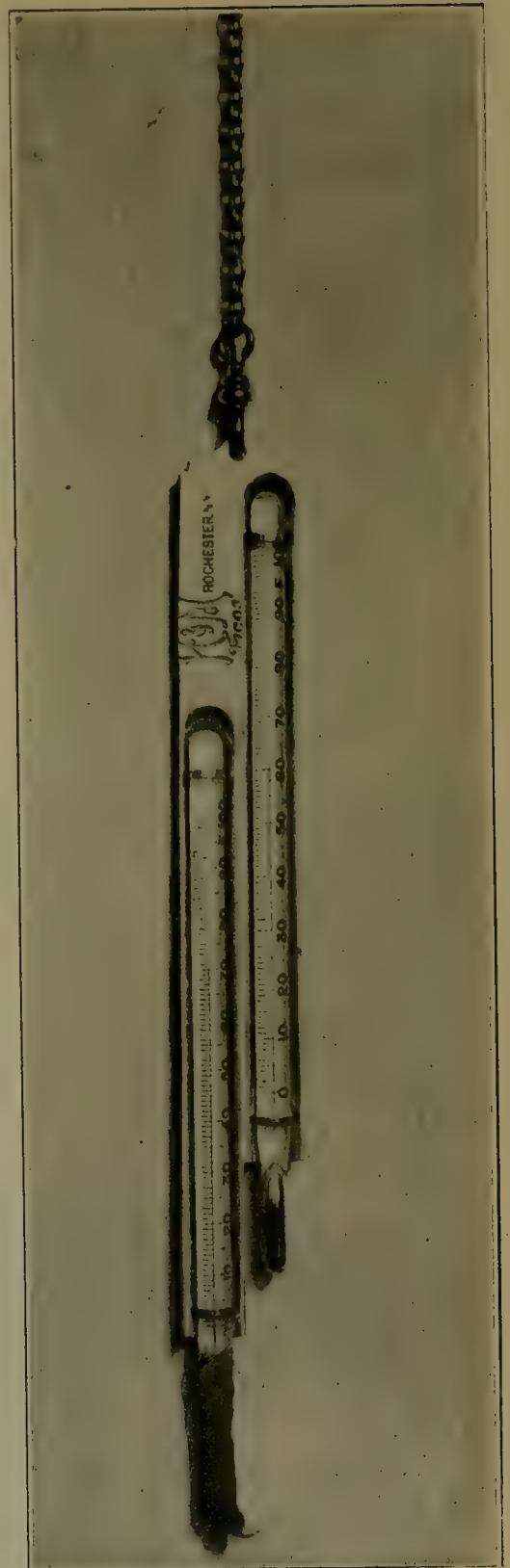


FIG. 6. SLING PSYCHROMETER

is at 40°F. What is the weight of one cubic foot of air under these conditions?

The weight of one cubic foot of saturated air at 29 in. and 60°F. is 0.07353. Call this *a*.

Decrease in weight per degree increase in dry bulb is 0.00016. Decrease for 2° is 0.00032. Call this *b*.

Increase in weight per 0.1 inch increase in barometer

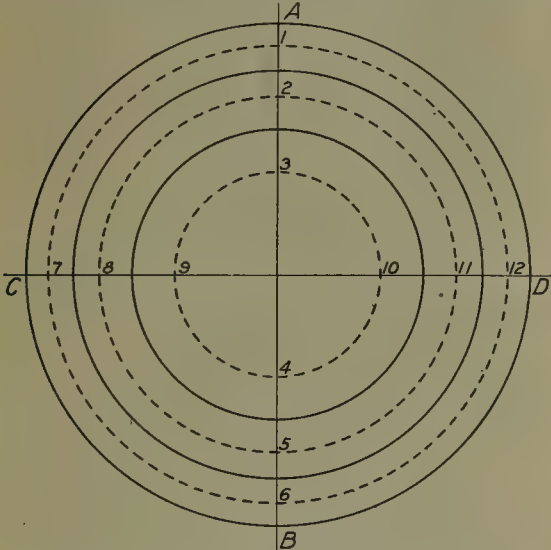


FIG. 7. PIPE TRAVERSE

is 0.00026. Increase for 0.3 in. is 0.00078. Call this *c*.

Increase in weight per degree difference between wet and dry bulb readings (see last column) is 0.000026. For 22° it is 0.000572. Call this *d*.

Weight of one cubic foot of air= $a + c + d - b = 0.07456$ lb.

To determine the pressure inside a pipe, the difference in pressure between the inside and outside of the pipe as shown by a water-gauge must be added to the barometric pressure outside.

DETERMINATION OF AVERAGE VELOCITY. If the air-duct is rectangular it must be divided into small rectangles, twelve or more, and the velocity determined in the centre of each rectangle. If the duct is circular, it is usually divided into three or more equal annular areas and four readings are taken on the central lines of each area. In Fig. 7 the heavy lines mark the boundaries of three equal areas and the dotted lines are the central lines of these areas. Two axes at right angles are assumed to cross the section and readings are taken where these axes cross the dotted lines.

A traverse of the pipe is made first along the axis *AB* by inserting the tube at *A* and taking readings at 1, 2, 3, 4, 5, 6. It is then inserted at *C* and readings taken at 7, 8, 9, 10, 11, 12. The velocities are calculated for each point and the average of these velocities gives the average velocity of the air in the pipe. To simplify the placing of the tube we should know the distance from the outside of the pipe to the points where the readings are taken. These distances may be obtained from Table No. 2, which gives distances from the edge of the pipe to the point on the traverse in percentage of pipe-diameter when three equal areas are used.

Table No. 2

Point	% of D	Point	% of D
1	4.5	4	70.4
2	14.7	5	85.3
3	29.6	6	95.5

For example, suppose the pipe 10 in. diam., the Pitot tube would be inserted through a hole in the side and

TABLE NO. 1

WEIGHTS OF SATURATED AND PARTLY SATURATED AIR FOR VARIOUS BAROMETRIC AND HYGROMETRIC CONDITIONS—Pounds per Cubic Foot													
Dry Bulb Temperature Degrees Fahr.	Barometric Pressure—Inches												
	26	27	28	29	30	31	32	33	34	35	36	37	38
	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air
	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air	Decr's Wt. per Deg. Inc. Dry Bulb	Wt. per Cu. Ft. Saturated Air
0	.07500	.00016	.07484	.00016	.07468	.00016	.07452	.00016	.07436	.00016	.07420	.00016	.07404
10	.07338	.00016	.07322	.00016	.07306	.00016	.07290	.00016	.07274	.00016	.07258	.00016	.07242
20	.07180	.00016	.07164	.00016	.07148	.00016	.07132	.00016	.07116	.00016	.07100	.00016	.07084
30	.07027	.00016	.07011	.00016	.06995	.00016	.06979	.00016	.06963	.00016	.06947	.00016	.06931
40	.06879	.00016	.06863	.00016	.06847	.00016	.06831	.00016	.06815	.00016	.06799	.00016	.06783
50	.06732	.00016	.06716	.00016	.06700	.00016	.06684	.00016	.06668	.00016	.06652	.00016	.06636
60	.06588	.00016	.06572	.00016	.06556	.00016	.06540	.00016	.06524	.00016	.06508	.00016	.06492
70	.06442	.00016	.06426	.00016	.06410	.00016	.06394	.00016	.06378	.00016	.06362	.00016	.06346
80	.06297	.00016	.06281	.00016	.06265	.00016	.06249	.00016	.06233	.00016	.06217	.00016	.06201
90	.06146	.00016	.06130	.00016	.06114	.00016	.06098	.00016	.06082	.00016	.06066	.00016	.06050
100	.05991	.00016	.05975	.00016	.05959	.00016	.05943	.00016	.05927	.00016	.05911	.00016	.05895
110	.05828	.00016	.05812	.00016	.05796	.00016	.05780	.00016	.05764	.00016	.05748	.00016	.05732
120	.05653	.00016	.05637	.00016	.05621	.00016	.05605	.00016	.05589	.00016	.05573	.00016	.05557
130	.05467	.00016	.05451	.00016	.05435	.00016	.05419	.00016	.05403	.00016	.05387	.00016	.05371
140	.05262	.00016	.05246	.00016	.05230	.00016	.05214	.00016	.05198	.00016	.05182	.00016	.05166
150	.05036	.00016	.05020	.00016	.05004	.00016	.04988	.00016	.04972	.00016	.04956	.00016	.04940
160	.04788	.00016	.04772	.00016	.04756	.00016	.04740	.00016	.04724	.00016	.04708	.00016	.04692
170	.04509	.00016	.04493	.00016	.04477	.00016	.04461	.00016	.04445	.00016	.04429	.00016	.04413
180	.04197	.00016	.04181	.00016	.04165	.00016	.04149	.00016	.04133	.00016	.04117	.00016	.04101
190	.03845	.00016	.03829	.00016	.03813	.00016	.03797	.00016	.03781	.00016	.03765	.00016	.03749
200	.03449	.00016	.03433	.00016	.03417	.00016	.03401	.00016	.03385	.00016	.03369	.00016	.03353



FIG. 8. PITOT TUBE FOR AIR

readings taken at the following distances from the edge of the pipe: 0.45 in., 1.47 in., 2.96 in., 7.04 in., 8.53 in., and 9.55 inches.

LABOR-SAVING DEVICE. To obtain the average velocity, it is incorrect to average the manometer readings, be-

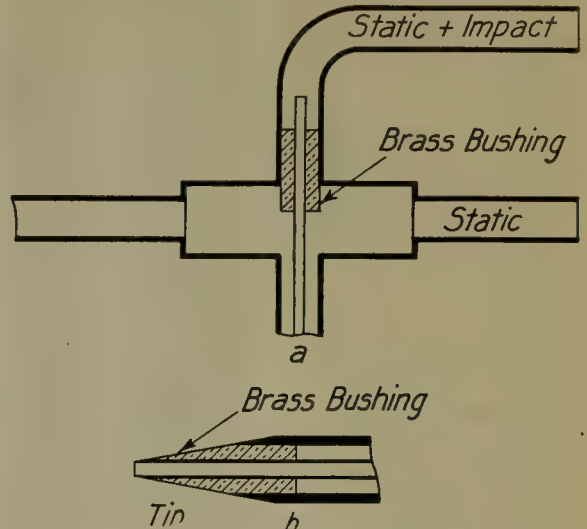


FIG. 9. DETAILS OF PITOT TUBE

cause the velocity is a function not of i , but of the square root of i .

$$V = 1097.4 \sqrt{\frac{i}{w}}$$

To obviate the labor of calculating the velocity each time, we may plot a chart with values of i as abscissae and $1097.4\sqrt{i}$ as ordinates.

$$\text{Let } A = 1097.4\sqrt{i}$$

We take our 12 readings in the pipe and for each manometer reading take the corresponding A from the chart. These values of A may be averaged. This average multiplied by $\sqrt{\frac{1}{w}}$ gives the average velocity.

Table No. 3 gives the values of A for different values of i . This is given in order that a large chart may be plotted.

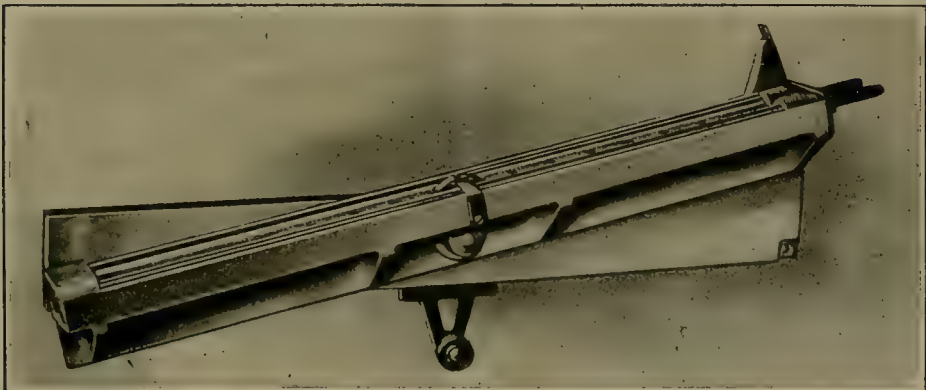


FIG. 10. INCLINED MANOMETER

TABLE No. 3

t	A
0.025	173.0
0.05	245.4
0.1	347.0
0.15	425.0
0.2	490.8
0.25	548.7
0.3	601.0
0.35	649.2
0.4	694.1
0.45	736.1
0.5	776.0
0.55	813.8
0.6	850.0
0.65	884.7
0.7	918.2
0.75	950.3
0.8	981.5
0.85	1011.7
0.9	1041.1
0.95	1069.6
1.0	1097.4

Every once in a while somebody pops up with the idea of saving labor in obtaining the average velocity by placing a lot of Pitot tubes in the pipe and connecting them with one manometer. The impact pressure varies with the square of the velocity, so the result will be that air will flow in through the tube where the pressure is highest, pass through the manometer and out through the other tubes. Such an arrangement might by chance give the correct result, but so might a ouija board.

CONSTRUCTION OF THE PITOT TUBE. Let us now consider the instruments with which we work. Fig. 8 is a photograph of a Pitot tube. The outside or static tube is made of seamless brass tubing 0.146 in. inside diameter. The inside tube is made of seamless brass tubing 0.046 in. inside diameter. The construction of the tube is shown

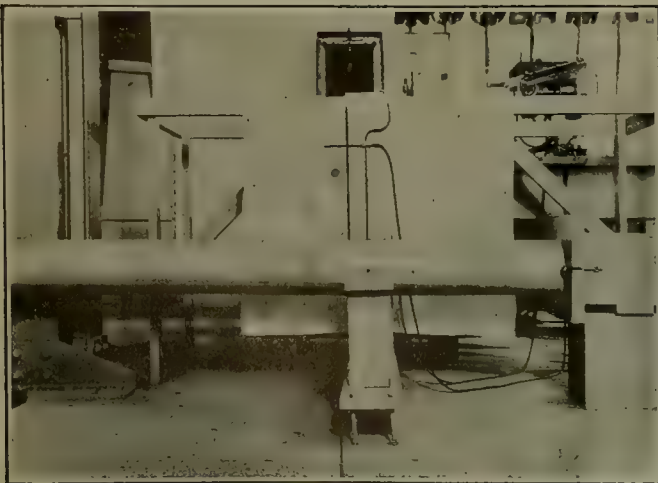


FIG. 12. A PITOT TUBE IN OPERATION

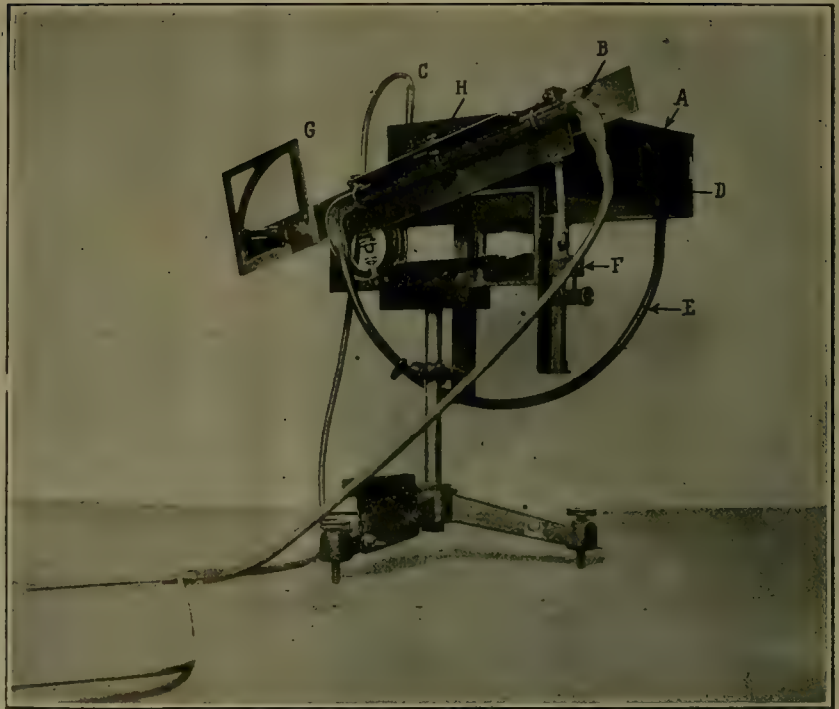


FIG. 11. INCLINED MANOMETER

in Fig. 9, *a* and *b*. The horizontal part *D*, Fig. 8, is about four inches long. Two holes are bored on the side of the outside tube two inches from the tip. The holes are 0.02 in diam. The rod *C* is for alignment. *A* connects with the inside tube, *B* with the outside.

Fig. 12 shows the manner in which the Pitot tube is mounted for traversing the pipe. Nails are driven in the frame for the support of the tube at such points as will place the tip of the tube at the correct position in the pipe.

THE MANOMETER. In Pitot-tube measurements we deal with very small pressures, so a very sensitive manometer is necessary. We can obtain any magnification desired by inclining the ordinary U-tubes. Fig. 10 is the American Blower Co.'s inclined manometer. This can be set for any magnification. Fig. 11 is a manometer that I had constructed for laboratory work. It is too cumbersome for the field. The air-tight tank *A* is one leg of the manometer and the glass tube *B* is the other leg. They are connected by the rubber tube *E*. The tank is so much larger than the area of the tube that the pressure is obtained by reading the rise in the glass *B* alone. The glass tube may be set at any angle by means of the slow-motion screw *F* and the clinometer *G*. The static plus velocity tube is connected at *C* and the static tube at *D*.

The glass tube is first set at the desired angle. The tank *A* is then adjusted until the

level of the liquid is at the lower end of the inclined glass tube. The zero of the sliding scale H is then set at the line of the liquid.

Although our calculations for velocity involve the weight of water at 60°F., water is not used in the sensitive manometers because it sticks to glass. Gasoline or alcohol of known specific gravity is used and the corresponding head of water calculated. I have been able to obviate this calculation by the use of the clinometer G . Suppose we are using alcohol and we wish a magnification of 5:1. We first get the specific gravity of the alcohol with a hydrometer standardized for water at 60°F. Assume that the specific gravity is 0.8. Now if we had water in the manometer, for a magnification of 5:1, the water would have to rise 5 inches along the incline to reach a vertical height of 1 inch or the inclination of the tube would be the angle whose sine is $\frac{1}{5}$. But we have a liquid that requires 1.25 in. vertical height to be equivalent to 1 inch of water. So if we wish to read directly in inches of water, of course, with the magnification, we

must set the tube at the angle whose sine is $\frac{1.25}{5}$. The magnification factor may be eliminated by re-numbering the scale and then we have an instrument in which we use alcohol instead of water and which magnifies the reading as desired and yet reads directly in inches of water at 60°F., which is the weight used in calculating the formula. The clinometers are stock instruments. They should have a vernier reading to five minutes at least. The value of one division of the level bubble is usually one minute, so if we set the vernier to the nearest five minutes, we can get two minutes with the level bubble and thus set the manometer to the nearest minute. The clinometer and re-numbered scale can be applied to the ordinary inclined U-tube. The position of the liquid can be read to a hundredth of an inch.

To be sure there is no misunderstanding of the use of the formula let us work one example. The manometer reads 0.2 in. The weight of one cubic foot of the air is 0.081. What is the velocity?

$$V = 1097.4 \sqrt{\frac{2}{w}} = 1097.4 \sqrt{\frac{0.2}{0.081}}$$

$$V = 1724 \text{ ft. per minute.}$$

[This is the third of a series of articles by Professor Weeks on the ventilation of mines. The first article, 'The Friction of Ventilating Currents', appeared in the issue of April 24, and the second, 'The Theory of the Centrifugal Fan', was in the issue of June 12.—EDITOR.]

Proposed Code of Ethics

A special committee of the American Society of Mechanical Engineers has submitted a 'Code of Ethics' for consideration by the Society. It is recommended that steps be taken to make the new code a joint effort of all the professional engineering and architectural societies; and that Engineering Council or a similar joint professional body be requested to appoint a committee from all the technical societies to prepare a new common Code

of Ethics, which can then be approved and adopted by individual organizations if they see fit. Suggestions are made as to the method of administering and interpreting the code, the articles of which, as recommended, are:

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client, and of loyalty to his country.

2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests, as well as those of the whole engineering profession.

3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.

4. He shall refrain from associating himself, or continuing to be associated, with any enterprise of questionable or illegitimate character.

5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.

6. He must inform his clients of any business connections, interests, or circumstances, such as might influence his judgment or the quality of his service to his clients.

7. He must not receive, directly or indirectly, any royalty, gratuity, or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.

8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.

9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.

10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from his client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.

11. He should do everything in his power to prevent sensational, exaggerated, or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.

12. He should not advertise in an undignified, sensational, or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.

13. He should not compete knowingly with a fellow engineer for employment on the basis of professional charges, or attempt to supplant a fellow engineer after definite steps have been taken toward the other's employment.

14. He should assist all his fellow-engineers by exchange of general information and valuable experience or by instruction through the engineering societies, the schools of applied science, and the technical press.

A Study of Electric Detonators

By CARL T. LONG and HUBERT L. PASCOE

INTRODUCTION. This paper is a preliminary report on a study of electric detonators that is being made in the mining department of the University of California, under the direction of Walter S. Weeks, Associate Professor of Mining. Help was also given by G. L. Greves of the department of Electrical Engineering. An investigation of elec-

alloy of platinum and iridium; it has a resistance of approximately 300 ohms per yard. About an eighth of an inch is used in each detonator. The resistance of the bridge when cold varies from 0.745 to 1.29 ohms. This variation might be due either to difference in length or in diameter. The diameter of the wire is 0.037 mm. and is constant within 0.002 mm.; consequently the variation must result from difference in length. Where soldered to the bare copper wires, forming the terminals, the solder



LEGEND





-  Sulphur plug.
-  Loose gun cotton.
-  Compressed mercury fulminate composition.
-  Sulphur

FIG. 1. CONSTRUCTION OF THE DETONATOR

tric detonators was made with the object of ascertaining the probable cause of misfires, and of determining a satisfactory method for connecting and firing detonators.

GENERAL CONSTRUCTION. The tests were made on instantaneous exploders, the construction of which is shown in Fig. 1. The current enters the exploder through one copper wire, passes through the platinum-iridium bridge of fine wire, imbedded in loose guncotton, and passes out by the other copper wire. When an electric current, direct or alternating, flows through the connecting wires the bridge is heated to a temperature that depends on the current, the bridge-resistance, the time, and the rate at which the heat generated is radiated and conducted away. Conduction takes place through the copper terminals to which the bridge-wire is soldered, and if the gun-cotton is not in close contact with the wire, radiation takes place through the surrounding air. The heat from the bridge lights the priming charge, which in turn ignites the detonating compound and causes the explosion. We do not know the exact composition of the detonating substance designated in the figure as fulminate of mercury.

THE PLATINUM-IRIDIUM BRIDGE. The bridge-wire is an

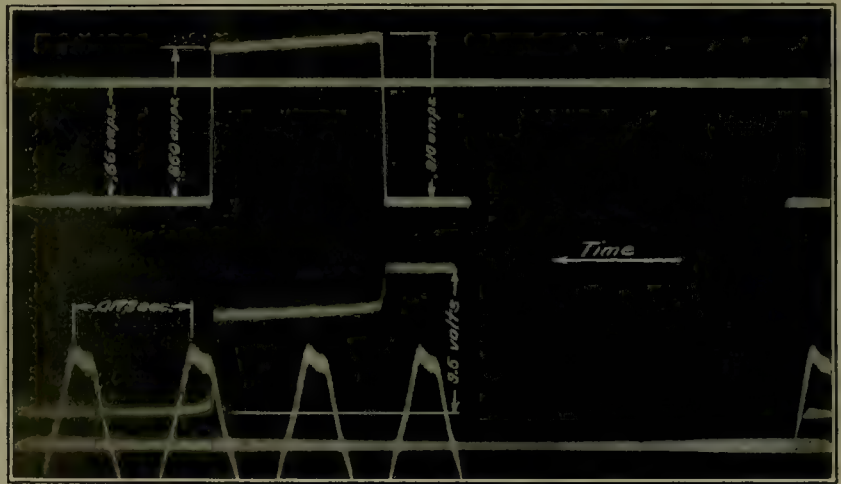


FIG. 3. TYPICAL OSCILLOGRAM



FIG. 2. MICROSCOPIC PHOTOGRAPH OF DETONATOR-BRIDGE

tends to run down the wire. This shortens the distance and decreases the resistance of the bridge. For the construction of the bridge see Fig. 2.

EFFECT OF CURRENT ON THE BRIDGE. Various currents were passed through the bridges. They became incandescent when the current was 0.40 amperes and broke at 0.70 amperes. This merely shows that the bridges will carry a current below 0.70 amperes without breaking.

USE OF THE OSCILLOGRAPH. The oscillograph is an instrument used in the observation of electric potentials or currents, as a voltmeter or ammeter, usually when the vibrations are too rapid to be indicated by the customary instruments. It is essentially a galvanometer of short period and can be used to obtain photographic records.

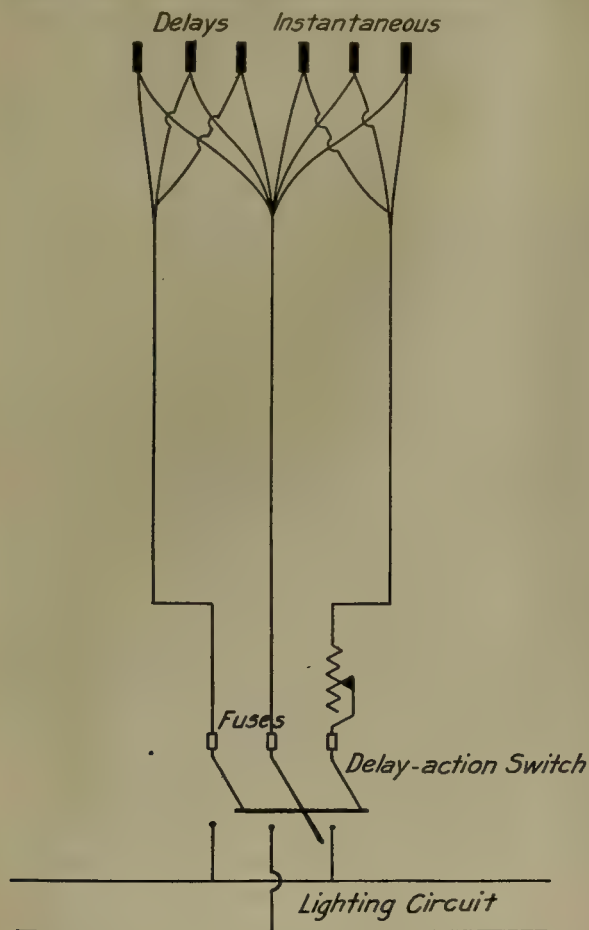


FIG. 4

It was used to determine the time required to fire a detonator and the effect of variations in current on this time; and indirectly to determine the number of units of electrical energy required to fire the different detonators and any relation that might exist between the resistance of the bridge and the time required to fire.

Fig. 3 is a typical oscillogram, showing the record of a detonator exploded under the following conditions: resistance of the bridge, 1.002 ohms; initial current, 0.910 amperes; final current, 0.860 amperes. The first horizontal from the top is a calibration line; the distance between it and the next horizontal, or the line of zero current, represents 0.66 amperes as indicated. Following

along the second line, which is that of zero current, we find that the current mounts to 0.91 ampere when the switch, used to include the detonator in the circuit, is closed. This value is readily determined by reference to the calibration line. For an instant 0.91 ampere is flowing through the detonator, but as the bridge-wire becomes heated, this current decreases on account of the increase in the resistance of the wire. This is indicated on the

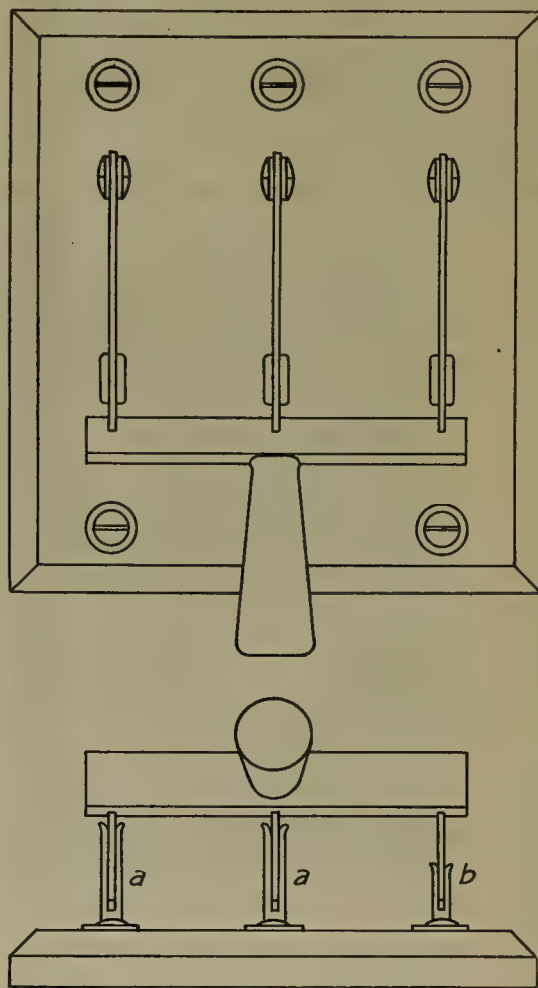


FIG. 5

oscillogram by the slope of the current line to the left to the point where the final current is only 0.860 ampere. Then, when the detonator explodes the circuit is broken and the current falls to zero. The third line, which is horizontal for a short distance on the left margin of the photograph, is a record of the voltage impressed. The fourth horizontal line is the zero line of the alternating-current curve shown. The alternating current was used to obtain a time-scale with which to compare the detonator-current curve. For example, the distance marked from crest to crest of the curve corresponds to 0.0173 second. This value corresponds to the frequency of a 58-cycle current. By comparison, the time required to

fire the detonator is found to be 0.025 second.

From the evidence of a great many oscillograms taken the following points seemed to be established:

1. The time required to detonate after the switch was closed varied from 0.04 to 0.0013 second.

2. The speed of detonation increased in proportion to the magnitude of the firing current.

3. The number of units of electrical energy required was found to vary widely, but occasionally results were obtained from one detonator that corresponded with those from others. Although we did not have sufficient information concerning the manufacture of detonators, we believe that this difference may be due to the work of different operators in loading the priming charges in the detonators, and that, if steps were taken to segregate those loaded by a particular operator, misfires from this cause would be decreased. It is apparent that the difference in the time of firing results to some extent from the fact that different amounts of electric energy are required, thus necessitating the flow of current for a longer time for some detonators. It must be remembered that the explosion of one of a number connected in series, as they commonly are, will break the circuit and prevent the remainder from exploding.

4. There is no definite relation between the resistance of the bridge and the time required to fire the detonator.

5. The current decreases as the bridge-wire heats.

Other experiments were performed to determine, if possible, a relation between the resistance of the detonator and the current required to produce explosion. The current was gradually increased until the detonator acted. The amount required varied from 0.35 to 1.00 ampere. The current and voltage at the moment of firing were recorded, but it developed that there was no fixed relation between the resistance of the bridge in an exploder and the current necessary to fire it. Two detonators may be connected in series and with a gradually increasing current one may be fired before the other. The remaining one can then be re-connected and fired on a higher current. A knowledge of the resistance of the bridge does not enable one to predict which exploder will fire first.

THE TEMPERATURE OF FIRING. It was thought that this difference in the amount of current required might hinge on the fact that more heat was required to ignite the priming charge in one detonator than in another. This might be accounted for by differences in the moisture content of the guncotton employed, in the specific heat of the platinum-iridium alloy, in the length of the bridge (causing different conduction losses to the copper terminals), or in the nature of the contact between the guncotton and the bridge.

The temperature of the bridge at the moment of firing was then determined, by a method based on the change in resistance of the bridge-wire in ohms per degree of increase in temperature. Then by employing the resistances when the wire was cold and just before detonation, determined by the drop-of-potential method, the change in resistance was calculated. By means of a chart on which

this change from 0° to 1500° had been plotted the temperature of the bridge was determined at the instant of firing. The results indicate that the temperatures vary through a wide range, owing to any one or all of the factors mentioned above.

PRACTICAL CONCLUSIONS. If detonators are connected in series the current may rise to a point that will fire some before the others are affected.

If detonators are connected in series to a high-voltage line, since they require different amounts of electrical energy and shoot at different temperatures, some will detonate and break the circuit before the others reach the temperature necessary for detonation.

The obvious conclusion is that detonators should always be connected in parallel and be subjected to a voltage sufficiently high to ensure a current of at least one ampere through each. The higher the current the better, provided that the line-fuses will not be blown. If the exploders are tested with a galvanometer and shot in parallel from high voltage, misfires will be reduced to a minimum.

In the delay-action exploder another element which may cause misfires is introduced, namely, a short fuse. If the cut-holes of a round, in either shaft or drift, are loaded with instantaneous exploders and the other holes with delay-action exploders, it has been proved that the detonation of the cut-holes may snuff the fuses in the delay-action exploders before they have had time to ignite properly. To obviate this difficulty, it is common practice to use a short delay in the cuts and a longer one in the other holes. This practice may be objected to for two reasons. One of the main arguments for the electric detonator is the fact that the simultaneous explosion of all the cut-holes produces a more effective blast than the same number of successive shots. Delay-action exploders can never be so accurately made that they will all explode at the same time. Even the instantaneous exploders will vary slightly in the time of explosion as we have shown. A more serious point to criticize in the practice of using delays in the cut-holes is the fact that we introduce another chance for misfires. A misfire in the side holes is not so serious, but misfires in the cut-holes cause the loss of the round. We suggest the following procedure.

Three wires are run to the face. The cut-holes contain instantaneous exploders that are connected in parallel to the line-wires as shown in Fig. 4. The side holes contain delay-action exploders connected in parallel to the line as shown. The line-wires are connected to the three-pole switch shown in Fig. 5. It will be noticed that the two left-hand clips (a) are of the same length but longer than the right-hand clip (b). The delay-action circuit is controlled by the left-hand and central clips, while the instantaneous exploders are fired by the central and the right-hand clips. As the switch-handle is pushed down, the delay-action exploders are lighted and get a good start before contact at (b) is made, to fire the cut-holes. The contact should be completed before the first delay fires and this will be accomplished if the switch is closed in the ordinary manner.

The Dorr Bowl-Classifier

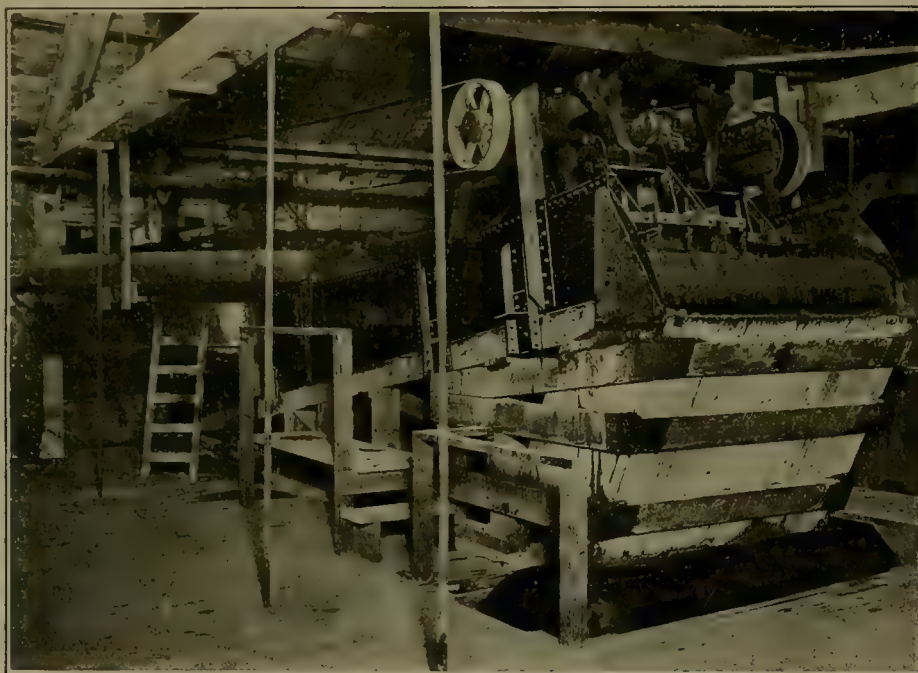
By HENRY HANSON

The chemistry of cyaniding was so well worked out by MacArthur, before introducing his process, that no improvement or additions of note have been made since its application to gold and silver ore; but this does not apply to the mechanical side of the process.

When this method of treating precious-metal ores was first introduced and became of commercial importance, the pebble-mill and the ball-mill were given no consideration, and the various types of filters, classifiers, thickeners, and agitators were unknown. These machines,

largely developed in connection with cyanidation, have played an important part, not only in cyanide plants but also in base-metal milling and other industries. The coal industry supplied the metal miner with his best conveying equipment, while the pebble-mill was taken from the cement industry.

rakes on the thickener-arms, the colloidal material and the fine, largely, going off in the overflow. The oversize and a small amount of undersize pass down through the opening in the bowl to the cleaning or raking chamber. This chamber is relatively small in area as compared to the upper compartment. The thickened pulp, upon entering the lower chamber, is subjected to agitation caused by the reciprocating action of the rakes and the back flow to the upper chamber. This stirring action, aided



THE BOWL-CLASSIFIER IN THE GOLDEN CYCLE MILL

by the upward current of the solution, tends to free the colloids and the fine from the coarser material and carry it back into the upper compartment, where it largely passes off in the overflow. Under the most suitable operating condition only a small amount of oversize is held in suspense and passes back into the bowl, where it again settles and is passed down into the raking-chamber. The oversize in the cleaning-chamber is raked forward in the classifier in the usual way. It is possible, of course, to have the agitation in the cleaning-chamber made so violent as to keep a great part of the mass in suspension, in which event great quantities of oversize will be carried back into the upper compartment by the back-flow. The bowl does not break down in its classification even under these conditions, but when operating the classifier with too much agitation in the lower chamber,

The hydraulic cone, the Dorr classifier, and the Dorr thickener all enter into the make-up of the bowl-classifier, the main features of these three being embodied in this single machine. It may be designated as a two-stage inter-return classifier; it consists first of a large settling-chamber in which the first step of the classification takes place; this upper chamber is really a small shallow thickener where the settled material is constantly being raked to the opening in the centre of the thickener by the

there is a tendency for a great amount of material to pass around from one chamber to the other, as if it were in closed circuit. Operating the machine under these conditions naturally reduces proportionately the amount of initial feed that it is possible to handle successfully in the classifier.

Great use is made of the backflow, but this cleansing wash must not be confused with that of hindered settlers, which accounts for the vastly increased capacity of the bowl-classifier as compared to the cone. It would appear, therefore, that, as compared to step-cone classification, equally good work can be done by the bowl-classifier, this machine requiring less attention in its operation. The capital cost of the bowl-classifier based upon the capacity as compared to cones should also be considerably less. As a separator of colloids, from sand, the work of the bowl-classifier at the Golden Cycle mill, at Colorado Springs, leaves little to be desired.

When a new or improved type of machine replaces another type of equipment successfully, the question naturally asked by the engineer is, what are its possibilities in other fields? It is too early, as yet, to answer such a query, but it would seem safe to predict that the bowl-classifier may become a worthy competitor of the cone and that the drag-belt classifier used in classifying the tailing from the primary or rougher cells into sand and slime, preparatory to table and secondary flotation concentration, may find in the bowl-classifier a machine that will make a closer separation of these products, owing to its greater flexibility, and that will yield itself more readily to the control of the operator.

For the treatment of oxidized copper ores, now found amenable to acid treatment by lixiviation, it is customary to use dry-crushers, the crushing being done by machines that make a minimum of slime, the operation being carried only to such a point as will allow free percolation of the entire product by acid solution. It is, however, likely that the grade and character of some ores of this type is such as to require finer ground material than can be leached without classification and a dual treatment of sand and slime, in which event satisfactory classification would become important.

R. S. Handy, superintendent of the Bunker Hill & Sullivan mill, is quoted* as saying, that if a complete removal of all colloidal material is made, there is little choice as to whether flotation or gravity concentration is used. While this may be true of some ores, it would nevertheless be unwise to apply this statement too broadly without making determinations on the ore in question; but, generally speaking, there is no doubt that a complete removal of colloids, followed by good classification delivering closely-sized products to suitable tables, will add greatly to the effectiveness of the work on the table. Just before flotation came into vogue great refinements were being made in gravity concentration, and no doubt these refinements would have been carried still further had not the successful introduction of flotation greatly simplified the problem of concentrating base-metal ores

when ground to a point where the valuable mineral is released from the gangue.

While the rake and spiral classifiers have played an important part, not only in cyanidation plants but also in flotation, working in close circuit with ball-mills or pebble-mills, there is, however, still room for improvement, as it is at present difficult to obtain an overflow of the necessary fineness from a standard rake-classifier without returning to the mill, with which the classifier is working in close circuit, from 20 to 30% of material already ground sufficiently to require no additional grinding. While it is not likely that a mechanical classifier will be developed that will entirely remove all material of the necessary fineness from the closed circuit, unless it is done by actual screen-sizing on wet pulp, such use of fine grinding has not proved a success owing to the high cost of maintaining the screens and the labor entailed in operating them. In large plants, where very fine grinding is required, the bowl-classifier, with suitable dilution of pulp, should offer, at least, some solution of the difficulty.

The overflow from a classifier, as to sizing, is dependent upon the character of the ore, the fineness of the grinding, the volume overflowing the lip of the classifier and the width of the lip, the amount of mechanical disturbance, and the dilution of the pulp. This last factor is by far the most important, as it is readily seen that the density of the pulp may be such as to prevent any settling or segregation at all. The bowl-classifier therefore has certain advantages over the rake or spiral classifier, such as the much greater overflow-area, that of a 15-ft. bowl-classifier being at the ratio of over 9:1 as compared to the standard rake classifier. The mechanical disturbance caused by the moving rakes is not transmitted to the overflow of the bowl and there is also a more complete removal of the colloids, due to the washing action of the back flow from the lower to the upper compartment.

When at Colorado Springs some time ago I saw a 15-ft. bowl-classifier at work in the Golden Cycle mill. From data given me by A. L. Blomfield, the manager, it would appear that with a feed ranging from 825 to 1650 tons per 24 hours the overflow ranged from 98.41 to 90.44% -200 mesh, the finer material in the overflow being obtained with the lighter feed. The dilution of the overflow was approximately 10 of solution to 1 of dry slime. From this it is apparent that the machine when operating under this ratio of dilution has its limitation as to the amount of +200-mesh material that can be run off in the overflow. The character of the overflow, however, is controlled by the dilution of the pulp and the volume of the back flow, but just how far these factors can be manipulated to increase the elasticity of the bowl-classifier would naturally become a matter for experimentation. The ore handled at the Golden Cycle mill is roasted, and it is quite likely that the capacity of the classifier would be somewhat effected by attempting to treat a non-roasted ore. This, however, should not be serious, as the overflow-area can be increased readily by enlarging the bowl.

*M. & S. P., March 27, 1920; page 459.

Some Features of the Geological Department of the Anaconda Copper Mining Company

By PAUL BILLINGSLEY

*The Anaconda Copper Mining Co., of Butte, has developed its geological department into an important branch of its organization. This has been the result of a number of factors, but perhaps the chief influences have been the character of the Butte orebodies and the methods of mining required for their development and extraction.

The Butte ores are contained in rather narrow veins in granite (quartz-monozite, to be exact). Widths range commonly from 2 to 20 ft. These veins are cut by at least six successive series of faults, the earlier of which also contain ore-shoots. Thus either in plan or in section the veins are broken and displaced at frequent intervals, the direction and amount of movement varying with each fault, but almost always being enough to throw the ore outside of the drift or raise. When it is considered that the high grade of the ore makes important the recovery of every fragment of vein, and also that many of these faulted fragments are too small to be hit by haphazard cross-cutting, the necessity for an understanding of the structure becomes apparent. From the mine operator's viewpoint it is essential to know promptly which way to turn a working; he is little interested in microscopic details of rock-alteration or theories concerning the source of mineral solutions.

ORGANIZATION. In 1900, an early date as mining geology goes, H. V. Winchell and D. W. Brunton organized a geological department for the Anaconda company, realizing that only the complete compilation of geologic data would solve the problem of fault-structure to the degree necessary for the proper aid to mining operations. The work thus begun has been greatly enlarged in scope and improved in detail under the direction of Reno H. Sales, chief geologist since 1906. F. A. Linforth, who in recent years has been in special control of the work in the Butte mines, has contributed many of the refinements of methods now in use. His paper presented at the Butte meeting of the A. I. M. E. in August 1913, gives an excellent outline of the work as conducted at that time. I follow his article in many points.

REQUIREMENTS OF MINING GEOLOGY. The geological department has thus from its formation kept for its prime objective the helping of the mine foremen and superintendents through a knowledge of the structure of the ground. Its members have realized that the geologist should be the servant of the man who is responsible for the work of the mine. As a result of 20 years of experi-

ment and progress, it has come to regard the following points as essential:

First, friendly co-operation and mutual respect between mine foremen and geologists. The geologist must be familiar with the foreman's plans in order to advise him intelligently, while the foreman must appreciate the value of geologic advice, and be prompt to seek it when in difficulty.

Second, prompt geologic examination of all new workings, in order that suggestions may be made without loss of time. Much useless work is thus prevented.

Third, accuracy in underground observation. Details of structure or of mineralization must be recorded exactly as they appear in the ground—big faults distinguished from minor slips; sequence of veins and faults at intersections properly interpreted; and important minerals, such as secondary chalcocite or primary chalcocite, observed and noted. To take notes properly frequently involves long study under very unfavorable conditions of air, water, ground, etc. Hazy or indefinite notes are only less useless than erroneous ones. If the geologist is not clear in his own mind as to which way the mineralization trends, or as to which of two faults is the intersected, and which the intersector, he should settle the point in the mine, with the evidence before him, and not use indefinite notes as a refuge.

Fourth, immediate platting of notes, and particularly of structural features, upon general geologic maps and sections, in order that the new evidence may be studied in its proper relation to that already accumulated. While I have just pointed out that decisions as to detailed structure must be made underground, it does not follow that general ideas can be correctly gained from that viewpoint. It is one of the most vital features of the work of the department that such general ideas are formulated only upon a study of all available details, each detail as accurate as it can be made by careful work with pick and compass. It is particularly important that one should not let his judgment underground be influenced by what he expects to find. Often a big fault does not come where it is expected; the reason will be discovered in due time.

Fifth, a smoothly-working system whereby conclusions reached by a study of geologic data are translated promptly into terms of mine operations.

METHODS. The means by which these fundamental ends are obtained have been described by Mr. Linforth, but may bear repetition here. Co-operation with foremen is a matter of state-of-mind. The geologist must be humble in spirit. Often the foreman knows more about

*A paper presented at the Western annual meeting of the Canadian Mining Institute in November 1919.

the geology of his mine than he can express in the geological language of professors. Generally he can teach the geologist much about mining methods. Experience would indicate that geologists who have used 'muck-sticks' in their past are apt to have a healthy state of mind in this respect.

Promptness has been secured by enlarging the force of geologists until each man can cover his territory in somewhat less than one month. Many foremen would like more frequent visits. Important faces are visited after each round. It has been found that while a geologist experienced in work at Butte can map correctly 25,000 ft. of workings per month, this gives too little time for the study of special problems in the mines, and does not permit enough trips with the foremen and bosses. At present I should judge that the members of the department cover about 6000 ft. of workings each per month.

Underground notes are taken on loose-leaf sheets on a scale suitable to the amount of detail desired, usually either 20 or 50 ft. to the inch. Colored pencils are used. Red represents vein mineralization, the ore being shown in darker color than the gangue. Blue is used for fault-gouge, light blue for slightly crushed rock, and heavy dark blue for strong clay selvage. With these conventions it is possible to make a drawing that absolutely reproduces the appearance of the face or back of a drift, showing to anyone familiar with the scheme the intensity of mineralization, amount of faulting, direction of drag, etc. The necessity of accurately reproducing the appearance of the ground is greater stimulus to careful observation. In this respect the Anaconda system is superior to others in which mere conventional symbols, such as red dots or crosses, mark the position of ore, or ruled lines of uniform width indicate faults. The fine distinctions which are perceptible underground should appear on the geological maps with equal clarity. Unimportant details such as joint-planes, etc., should be ignored.

In Butte, geological maps are based upon the co-ordinate system used by the mine-engineers. Sufficient sets of convenient size are made to cover the entire district in checker-board manner. The maps are on tracing-cloth, with a separate sheet for each level. In addition to the regular working-set on a scale of 50 ft. per inch, sets on scales of 100 and 200 ft. to the inch are maintained. Mine-foremen are provided with 100-ft. maps covering their own mines, and these are kept up to date by the department. It is of prime importance that the foremen should have for daily use a set of maps on which the geologic structure is shown. The expense entailed by the preparation and maintenance of these foremen's sets is more than repaid by the saving in underground work which results from their use. Cross-sections, generally on a 100-ft. scale, are made at sufficiently close intervals to cover all details of structure. In many parts of the district a cross-section every 100 ft. is essential. It has become axiomatic among members of the department that the preparation and study of these cross-sections

is one of the most fruitful methods of using the geologic data. It may be stated without reservation that even those most accustomed to using maps and thinking in terms of three dimensions seldom fail to profit by the use of cross-sections. Many an unexpected orebody has been found through their assistance. They are too seldom employed in general.

In order to transmit to the proper officers the geologic conclusions reached, a system of 'recommendation sheets' is employed. These sheets are made out by each geologist as he reaches his conclusions. They carry the following information: mine, level, description of recommended work, object of recommended work, approximate distance to be run, date of recommendation, result (to be filled in later). The recommendations of the subordinate geologists are submitted to Messrs. Sales or Linforth for approval, and if endorsed, are forwarded to the mine-foremen for execution. Duplicate copies are filed for the information or action of the general superintendent. It has been found desirable to keep each foreman supplied with a large number of recommendations for each working level, in order that he may carry out the suggested work at the time most convenient to his general operations. Recommendations requiring immediate action are appropriately marked.

CONCLUSIONS. This outline covers the routine work of the Anaconda Geological Department. I have purposely emphasized those features in which I believe it to excel—for instance, the close co-operation with the men in the mines, the accuracy and detail of the notes taken, and the concentration of attention upon the structure of the ground. Its excellence in these lines may be attributed both to the special problems of Butte geology and to the good leadership and direction which have solved them.

The problems which other mines present to the geologist are not always the same as those of Butte. In some districts mining operations depend less upon structure, and more upon such matters as the genesis of the ore and its association with certain rocks. But the correct interpretation of these points cannot be made without the preliminary work of thorough and detailed mapping of the veins, rocks, and faults. From this structural work alone can the succession of geologic events which have created and localized an orebody be worked out in the proper sequence, and upon this knowledge alone can underground prospecting and development be successfully conducted. With the recent great and justified expansion of the use of the microscope in geological study it is perhaps well that conditions in Butte have combined to prevent this from resulting in a neglect of overalls and pick as essential tools of the mining geologist.

JAPAN has forged ahead to leading position among the foreign countries using American copper, a total of 117,354,241 lb. having been exported there during the nine months ended March 31. This is all the more interesting when it is realized that not a single pound was sent to Japan in the corresponding period last year.

Proceedings Against Minerals Separation Before the Federal Trade Commission

The calling of a former Federal Trade Commission Examiner to the witness-stand to inquire into his present relations with the Minerals Separation interests, his admission of visits (for purposes undisclosed) to the offices of both Minerals Separation North American Corporation and A. A. Cook, its counsel, since the commencement of the hearings, and statements by the Government prosecutor contradicting the witness, featured the resumed hearings of this case in New York on May third.

After the introduction of numerous exhibits in evidence on May third and fourth, Gaylord R. Hawkins, the Government prosecutor, upon completing a further examination of the president of Minerals Separation North American Corporation, startled those present by calling to the witness-stand Henry I. Foster, who was one of the Commission's original investigators of the Minerals Separation companies. Foster left the Commission on April 14, but has been a regular attendant at the hearings since then, at nobody's request, he said, but "merely as a visitor". The prosecutor's questions brought out admissions of visits by the witness to the Minerals Separation North American Corporation offices, as well as to the office of its attorney, but these visits "were not in connection with this case", according to the witness.

Foster denied that he was now employed by the North American Corporation or its counsel.

Mr. Hawkins asked the witness if he had not said that the income of the North American Corporation for the last year had been fourteen million dollars. This question stirred North American Corporation's counsel, as had all previous inquiries into the financial affairs of his clients. "I object to that as incompetent, irrelevant, and immaterial, hearsay of the most objectionable kind or character." The question was allowed, and Foster denied making such a statement. "He said it, all right," commented the prosecutor.

"What information have you, Mr. Cook, regarding the records of the Federal Trade Commission?" asked the prosecutor. "I have never seen them," replied Cook. This answer caused Mr. Hawkins to probe further. "Have you received any information, directly or indirectly, from anyone, as regards what these records and files of the Federal Trade Commission contain with respect to this case?" To this Cook answered, "I have received no information from anyone connected with the Federal Trade Commission as to what the records contain. I have no recollection of having been told by anybody what the records contain," and proceeded to explain that his remark to the Examiner had been based on inferences he had drawn from circumstances surrounding the case.

Mr. Cook, while he did not reveal the subject matter

of Foster's visits to his and to North American Corporation's offices, flatly denied the employment of Foster by him or his client.

A letter written by John Ballot, president of North American Corporation, to his counsel in 1918 was introduced in evidence by the respondents, and it refers, among other things, to the "enormous benefits derived from the unlicensed use of our process", and to "the enormous profits derived by them from the illegal use of our patents." Such profits, of course, being made by alleged infringers, were not reduced by the payment of the royalties exacted by North American Corporation. Some correspondence introduced by the Government is enlightening on this subject.

"We should like to make arrangements with your Company to use the Minerals Separation Company's process, if it can be done on the basis of the flotation concentrates produced," reads a letter from a prospective licensee. This was answered by North American Corporation, quoting their royalty-rates. The prospective licensee was prompt in his reply, "A license to use your process under the terms stated would be of no value to us." "If a more favorable basis for royalties cannot be had we shall be obliged to discontinue consideration of your process." And later, "A royalty on the mill-heads would amount to more than the net value of the concentrate produced. If you could give us a reasonable royalty based upon the flotation concentrates produced we would be willing to contract with you." The last word from this prospective licensee is brief but pointed, "The experiments were discontinued about the first of the year and since the apparatus has been dismantled and removed from the building."

Another company which had been experimenting with the process, assisted by a North American Corporation engineer, wrote as follows:

"The situation is that, as it is at present operated, the plant is not successful in any large way, and if we were to continue with our present indifferent results and were to pay your royalty in addition, we might almost as well suspend operation."

And on the subject of the demand of North American for double royalties on material treated during the experimental period, as "the unlicensed use of flotation":

"Your proposal acceptable except for the demand for past royalty. This work has been so unsuccessful to date that I wish you would waive this claim or make it subject to the complete success of the experimental work now proposed."

The chief engineer then took the matter up with the president, and advised the company of a lump sum that would be acceptable in full settlement. This "very large figure for settlement appalled" the company (which had

already been licensed), and they wrote:

"Had I known or realized that that accrued penalty was to hang over the head of the company, I should have dropped the matter where it was rather than go into the experimental work proposed with the outcome in doubt; and in that telegram I said that any such back royalties would be contingent upon highly favorable results. The Malmros work and the expenses incident thereto ran to a large figure, and the results were not gratifying and certainly in no degree commensurate with what I hoped we might get by reason of your laboratory tests, which indicated the possibility of trace tailings." . . . "We then tried faithfully under Mr. Malmros (the Minerals Separation engineer) to make a success. Our outlay direct for his per diem and expense was \$650; the collateral expense was at least \$200 in addition. Had you refused point blank to waive past royalties, almost certainly we would have saved these charges and dropped the work. As it was we went ahead and paid for work the successful outcome of which was a matter of common interest.

"A point that hurts me is that you reported tailings assays of trace and 20 cents (notation above), and this possibly led me on. Yet when I put up these figures to Mr. Malmros as a goal, he discounted them as mere laboratory results not to be obtained in practice. I had relied on them."

In a letter to North American, E. H. Nutter, the company's chief engineer, discussed the subject of royalty rates with refreshing frankness. "I know your views on the royalty question," he said, "but here is a case where, if we charge them an all-round royalty on all of their operations using flotation of say 10c. a ton or a royalty that would amount to this charge, it is I think all the traffic should bear. I am becoming more and more convinced that our royalties are too high, and am getting together data which I think will show that we are losing out financially through charging a royalty which is considered too high." And, further, "The only argument that I can see," continued Mr. Nutter, "is that by maintaining our present position we can hold the Butte & Superior company up for more than we otherwise might, but this, again, is not certain in my mind, as I understand the law is very definite that all of the profits of infringement belong to the patent owner and that our scale of royalties to non-infringers will not be considered."

In the same letter, Mr. Nutter discussed the experiments of United States Smelting, Refining & Mining Co. with flotation at various mines. He reported that at Pachuca "they figured that they could make about \$14,000 per month operating profit from the use of flotation, not counting royalty, but out of this they would have to amortize their smelting-plant and the changing over to flotation. The royalty would take all of this, and they would not make any profit at all from the change; and he stated that they had stopped all investigations of flotation on this ore after receiving our royalty schedule." At Needles only one-sixteenth of their products was obtained by flotation, and "at normal metal prices their profit would not amount to the royalty

we are asking of them, and they would scrap their whole plant there."

Just why the North American Corporation was formed, and what interests control it were disclosed in correspondence introduced by the Government between (1913) Ltd. and British Treasury officials in 1916. One paragraph reads as follows:

"The profit-earning capacity of the company is very great, and every effort should be made to develop it to its full extent and to preserve the process for its British shareholders. The company's position at present is that it has to defend its extremely valuable property against the assaults of the larger portion of the powerful American mining interests whose avarice will not permit any scruples to stand in their way, if by any chance they can crush the company, in spite of the enormous profits they are making or will continue to make even after paying the moderate royalty demanded. . . By transferring the company to America on the lines proposed, the shares would still continue to belong to and be held by exactly the same shareholders now on the British register, and in exactly the same proportion, except that 7% of the whole share capital will be contributed by shareholders and used to cancel or commute the payment to the Agents of 10% of the gross income, as fully explained above and in the Agreement of 4th August, 1916."

That the process has been "preserved to its British shareholders" is confirmed by an inspection of the stockholders' list of the North American Corporation introduced in evidence. Except for the several alien stockholders residing in the United States and stock held by the Alien Property Custodian there are but five American addresses out of some two hundred, all the rest being foreign, and these own but 10,500 of the 500,000 shares!

MINERALS SEPARATION'S VIEW OF AMERICAN JUSTICE

"In one notable instance, at the hearing by the San Francisco Appeal Court of an appeal against the company, the opposing counsel actually told the Court that the company was a foreign corporation and alleged that it was trying to exact a tribute from the United States mining industry 'equal to the National Debt'. The Court, no doubt, influenced by this consideration, decided against the British company, but that decision has since been called up for revision by the Supreme Court in Washington, hence the need for expediting the transfer to American registration to assist as far as possible in counteracting any prejudice which may exist or be insinuated against the British company at the final hearing of this and two other important actions pending at present before the Federal Courts of the United States. . . . If the transfer of the English company to America is not soon allowed, the existing hostility in America against the company will not only increase, but as has already occurred may again be used to prejudice the company's cause in the three actions at present before the Federal Courts of the United States."

The hearings in New York adjourned on May 5. They will be resumed sometime after the first of June at such place as may be decided upon by the Commission.

Minerals Separation v. Miami Copper Company

Affidavit of Theodore J. Hoover

STATE OF CALIFORNIA } ss
County of Santa Clara }

BE IT REMEMBERED that on this Thirteenth day of May, A. D. 1920, personally appeared before me, C. E. JORDAN, a Notary Public of the State of California, THEODORE J. HOOVER, known to me personally to be such, who being by me first duly qualified according to law, deposes and says:—

I am a Mining Engineer by profession, having graduated at Stanford University in the year 1901. Since my graduation I have practiced my profession and have acted as superintendent and manager of mines and mining properties, and also as general consultant, director and officer of various mining companies. In April of 1919 I was appointed Professor of Mining and Metallurgy at Stanford University, and since September of 1919 have been in charge of the Department of Mining and Metallurgy at Stanford University.

In the year 1906 I was engaged as General Manager by Minerals Separation, Limited, the above-named defendant.

At that time (1906) Minerals Separation, Limited, was the owner by assignment of the English Patent No. 7803 of 1905, granted to Messrs. Henry L. Sulman, Hugh F. K. Picard and John Ballot. This patent was for Improvements in Ore Concentration, and was then generally spoken of by the officers, engineers and agents of the said company as "the oleic-acid-froth patent" or "the frothing patent", to distinguish it from the Cattermole "granulation" process owned by the same company; and at a later date was referred to as "the agitation-froth patent" or "the Minerals Separation process patent". This patent is the English equivalent of the United States Patent No. 835,120, granted to the same persons, which has been spoken of in this litigation as the first patent in suit. The United States Patent No. 835,120 was not assigned to Minerals Separation, Limited, by the patentees until December 1909.

At the time of my entry into the service of Minerals Separation, Limited, Henry L. Sulman and Hugh F. K. Picard were acting as Consulting Metallurgists of Minerals Separation, Limited, and so continued to act, certainly until 1916; and, so far as I am informed, are still so acting. Shortly after entering the service of Minerals Separation, Limited, I was informed by John Ballot, who was at that time President of Minerals Separation, Limited, that I could inform myself as to the technical and scientific side of the flotation processes by having recourse to Messrs. Sulman and Picard; that Messrs. Sulman and Picard had prepared a treatise on "The Theory of Concentration Processes Involving Surface Tension", and that in all probability I would be permitted to read this treatise if I approached Messrs.

Sulman and Picard upon the subject; that the treatise was a full and complete one developing the whole subject in a scientific and satisfactory manner.

In due season thereafter I sought out Messrs. Sulman and Picard in this connection and discussed broadly the technical and scientific aspects of flotation processes. These discussions between myself and Messrs. Sulman and Picard continued throughout the term of my engagement with Minerals Separation, Limited. At one of the first interviews on this subject with Messrs. Sulman and Picard the existence of the treatise, above referred to, was aluded to by Mr. Sulman, and a copy of this treatise was handed to me by Mr. Sulman some time during the first half of 1907. No request has ever been made by either Messrs. Sulman and Picard, or by any other person, for its return, and it remained continuously in my personal possession until December 27th, 1919, from which date Mr. John F. Neary has also had access to it, under circumstances which I shall describe in a moment.

During the four years of my connection with Minerals Separation, Limited, and subsequently, I have read this treatise many times and am thoroughly familiar with the views of the authors as expressed therein.

I severed my connection with Minerals Separation, Limited, in December of 1910, and since that date have not been in their service or employ in any capacity.

In August of 1919 I was interviewed by Mr. John F. Neary, counsel for the Miami Copper Company, with relation to the early history and development of flotation processes. As a result of this and subsequent interviews, I have carefully examined the Appeal Record in this case, as well as the record of the proceedings before the Master on the accounting. From such examination of the record I learned that the present contentions of the complainant therein as to the scope of United States Patent No. 835,120 are so entirely opposed to the statements of two of the patentees as contained in the treatise, above referred to, as to amount, in my opinion, to an attempt to perpetrate a fraud on the court and to impose an unwarranted and unjustifiable burden upon the mining industry of the country.

The treatise referred to fully develops the knowledge of said Sulman and Picard, and their understanding of the art prior to the date of application for the first patent in suit, and their statement of such prior art is wholly inconsistent with the position for which their assignee, Minerals Separation, Limited, is now contending in this case.

I then sought and received legal opinion as to my obligation under the contract of employment with Minerals Separation, Limited, above referred to, and I have been advised and I believe that I am free from any duty to remain silent as to the existence and contents of said treatise under the circumstances of this case, particu-

larly as I believe that the rights of the public are also involved.

The Miami Copper Company, the defendant in the original suit, complainant in this proceeding, its officers, agents, attorneys or servants, did not know, through me or through others as far as I know, of the contents of this treatise until October of 1919, when the treatise was submitted to counsel for inspection and opinion as to its competency and materiality as a matter of evidence in said litigation. Owing to the fact that I reside and am actively engaged in teaching at Stanford University, California, and that counsel and the officers of the Miami Copper Company reside and are engaged in business in and about New York City, the said treatise, entitled "The Theory of Concentration Processes Involving Surface Tension", was by me deposited in a safe in the New York Produce Exchange Safe Deposit & Storage Company, on December 27th, 1919, Mr. John F. Neary and myself being the only persons who were given the right of access thereto. I happened to be in New York at that time and was about to return to San Francisco; I was then still considering the propriety of permitting the use of this treatise in this case and deposited it in the safe, and gave Mr. Neary right of access thereto, in order that it might readily be obtained in the event that I finally determined that it might properly be used. I so determined on April 12th, 1920, and at that time authorized Mr. Neary to use the treatise.

The said treatise has been in my possession, and under my sole control, continuously from the date of its receipt by me from Mr. Sulman, as hereinabove described, until it was placed in the safe as aforesaid; no part of said treatise was, during my possession, abstracted or changed in any respect, and nothing was added thereto; the said treatise being, when placed in said safe, in exactly the condition in which it was at the date of its delivery to me, except insofar as the elements, time and the ordinary wear and tear in its perusal may have resulted in dimming and discoloration.

THEODORE J. HOOVER.

Sworn to and subscribed before }
me, this Thirteenth day of }
May, A. D. 1920.

C. E. JORDAN.

[NOTARIAL SEAL].

Affidavit of William S. Stevens

STATE OF ILLINOIS }
County of Cook. } ss

BE IT REMEMBERED that, on this seventeenth day of May, 1920, personally appeared before me R. R. McCormick, a notary public of the State of Illinois, WILLIAM S. STEVENS, known to me personally to be such, who, being by me first duly qualified according to law, deposes and says:

I am 36 years of age and reside in Chicago, Ill.

I am now in the employ of the Sherwin-Williams Co., manufacturers of paints, and have been so employed since the year 1910. My headquarters are at Pullman

Station, Chicago, Illinois. I am a Metallurgical and Chemical Engineer and an Associate of the Institution of Mining and Metallurgy.

In the year 1906, I entered the employ of Minerals Separation, Limited, a Corporation of Great Britain, and continued in such employ until September 1910. During the year 1907, I was acting as a laboratory assistant, working under the general directions of H. L. Sulman and H. F. K. Picard, Consulting Metallurgists of said Minerals Separation, Limited. During the month of December 1907, at the direction of said Sulman and Picard, I conducted a series of tests in London, England, on the use of centrifugal pumps as the agitating means to produce the condition of aeration considered necessary in the process of the English Patent, No. 7803 of 1905, issued to Sulman, Picard and Ballot (the English equivalent of the U. S. Patent No. 835120, issued to the same parties). In these tests a Gabbett mixer, such as those shown in Complainant's Exhibit, Sulman Drawing, accompanying Report, May 3rd 1905, appearing at page 85, Volume IV, Appeal Record, in the case of Miami Copper Company *versus* Minerals Separation, Limited, was used for mixing the ore, water and acid. The pulp so mixed was delivered from the Gabbett into a funnel feeding the centrifugal pump. Into this funnel was fed oleic soap solution containing oleic acid in an amount equivalent to two-tenths per cent. on the ore. The pump delivered the oiled pulp to a following spitzkasten, wherein little or no froth was obtained as a result of such treatment in the centrifugal pump. Using the same procedure and the same apparatus, an experiment was conducted in which air was introduced into the centrifugal pump with the pulp. No improved results were obtained in this experiment. Subsequently a second pump was installed, following the first pump, and the same procedure was carried out, as before, the pulp passing through the two pumps after the addition of the oleic soap solution in the funnel feeding the first pump. There was no substantial difference in the result, by reason of the use of the additional pump.

This series of experiments covered all possible variations of treatment with the apparatus above described, and as the result of these tests, the said Sulman and Picard stated to me that they had concluded that the use of centrifugal pumps did not result in the production of the aeration considered essential in such process for the production of a froth, and instructed me to discontinue the use of the centrifugal pump as an agitator in the operation of said process.

WILLIAM SIDNEY STEVENS.

Sworn to and subscribed }
to before me, this 18th }
day of May 1920.

R. R. McCORMICK.

[NOTARIAL SEAL]

SALES OF COPPER, including both foreign and domestic transactions during May, totaled 62,000,000 lb., compared with 101,000,000 in April and 320,000,000 in March.

REVIEW OF MINING



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NUMEROUS FLOTATION PLANTS NEAR PRESCOTT.

PRESCOTT.—The oil-flotation process is highly successful in the treatment of ores in Yavapai county. There are five mills using the process, treating silver-gold ores, namely: the L. T. S. custom mill, situated four miles south of Turkey; the Pocahontas mill, two miles south-east of Mayer; the Anderson-Birch mill, two miles west of Humboldt; the Black Diamond, at Walker; and the Monte Cristo on Groom creek, eight miles south of Prescott. The ore treated varies from a simple gold-silver product such as the Monte Cristo to a complex ore of copper, gold, silver, lead, and zinc such as is found at the Pocahontas mine. The precious metals predominate. Two mills are using the process on copper ore: the Arizona Binghamton at Stoddard, five miles east of Mayer, and at the Consolidated Arizona Smelter Co.'s plant at Humboldt. The ore treated is a chalcopryite copper. Several old mills are being converted into flotation plants and one new mill, the Abe Lincoln, north of Wickenburg, is about to start with a daily capacity of 100 tons. The Peak Silver Mining Co., recently organized, proposes to install the process in two old mills on Groom creek. There are many old properties south of Prescott, as far as Tip Top, 65 miles, that were worked many years ago for the free gold and silver. These afford excellent opportunities with the flotation process. There are possibly 25 old amalgamation mills that could be converted into the newer flotation units.

The Peak Silver Mining company has opened an old vein of high-grade gold-silver ore in the Black Horse mine, one of six old properties recently taken over by the company. The vein is three feet wide, the ore valued at from \$30 to \$154. Three carloads of high-grade ore were shipped from the mine 30 years ago. J. E. Pierson of Prescott is general manager. The company plans extensive development for all six properties. An important strike of copper has been made at 980 ft. in the United Arizona mine, 16 miles west of Cordes. The shaft penetrated a vein 14 ft. wide said to average 25% copper. It is considered one of the richest discoveries made in the county. C. J. Bendewald, of Mayer, is the general manager. The mine is to obtain electric power from the Arizona Power Co.'s wire which passes close by. Plans have been completed for a 100-ton oil-flotation plant at the Silver Belt mine, two miles west of Humboldt. Regular shipments of ore are made to the Humboldt smelter. H. H. Burt, of Prescott, is the consulting engineer.

BISBEE.—The Shattuck Arizona Copper Co. reports for the quarter ended March 31, total receipts of \$44,902 and net income after depreciation, etc., of \$55,740. Metals recovered from copper ores during the quarter were: copper, 1,002,292 lb.; gold, 215 oz.; silver, 26,332 oz. Metals recovered from lead concentrates were: lead, 1,902,791 lb.; gold, 934 oz.; silver, 51,198 oz. Metals recovered from lead ores were: lead, 17,948 lb., gold, 7 oz.; silver, 396 oz. The net income is equal to nearly 16c. per share of stock for the quarter.

JEROME.—The tunnel of the Shea Copper Co. has been advanced 725 ft. and shows the vein to have a width of 12 ft., 30 in. of which is ore. Samples show an average value of \$30 per ton in silver and copper. Preparations for stoping and shipping are to be made immediately. It is reported that the United Verde Extension Mining Co. has taken an option on the Chief property, which adjoins the Shea.

OATMAN.—The report of operations of the United Eastern Mining Co. for the first four months of the present year shows that 38,210 tons of ore was milled with a gross value of \$752,631 and a bullion recovery of \$727,686. Operating costs were \$317,515, leaving a net operating income of \$410,171.

TUCSON.—A strike of high-grade silver ore has been made on the property of the Sherwood Copper Co., which is located in Comabobi district. The ore was opened on the 145-ft. level while drifting on a stringer. It is said the vein contains native wire silver, is three feet wide, and assays as high as \$700 to \$800 per ton in silver. High-grade ore is now being sacked and shipped. The St. Louis mine at Greaterville is now being operated, having been taken over by the Liberty Silver Mines Co. The old St. Louis shaft is being sunk to greater depth, having now reached the 145-ft. level. At this point the vein has widened considerably. A compressor and other necessary machinery have been installed to carry on development.

COLORADO

DIVIDENDS FROM CRIPPLE CREEK MINES.

CRIPPLE CREEK.—Interest in the district is now centred in the north end, where diamond-drill exploration to determine presence of eruptive rocks under the granite capping is shortly to commence. Equipment has already arrived and has been unloaded at the Gillet awaiting transportation to the camp to be established on the Wild ranch in the saddle between Tenderfoot hill and Rhyo-

lite Mountain. The point for the first hole was selected last week by George H. Stahl, general manager for the Vindicator Consolidated Mines Co., W. R. Ryan, superintendent, and Harry W. Robinson, the drilling contractor. No attempt will be made to find ore or mineralized dikes. The first and possibly the second drill-holes will, it is expected, determine if eruptive is present under the granite. If the eruptive is found at an economical depth a three-compartment shaft will be sunk, and diamond-drilling will again be resorted to for further prospecting.

With the payment, on June 10, of the monthly dividend of \$30,000 the Golden Cycle Mining & Reduction Co. announced that future distributions will be quarterly as earnings warrant. Stockholders of the Cresson Consolidated on June 10 were advised that net earnings for the months of February, March, and April totaled \$160,521. The company, as of May 31, had cash in bank amounting to \$276,121, and unsettled ore at mill of an estimated value of \$10,000. Ore-reserves as of May 1, 1920, have an estimated value of \$1,523,985.

IDAHO SPRINGS.—Vacant mining ground near here was located only last week and the location certificate for the Virginia B. lode, 350 by 1500 ft., was filed for record by W. J. Baker, manager for the recently organized Metals Mining & Leasing Co., operating the Jenny Lind group. The claim, named after his daughter, lies along the line of the Big Five tunnel. A shaft was sunk below the wash, and three feet of vein matter exposed carries some silver. Mr. Baker proposes to cross-cut and search for the vein from the Big Five tunnel, that cuts the claim at a depth approximately 2000 feet.

SILVERTON.—The Gold King Extension Mines Co. has resumed work in its stamp-mill with 40 stamps dropping and will increase to full capacity of 80 stamps as soon as men can be secured at the mine and mill. The shipment of concentrate to the smelter is going on and three cars daily are leaving the property. With the full force working, 300 tons of ore will be required by the mill.

OURAY.—Boston capital has become interested in development of the Superior and Bonanza King properties, with E. H. Manhire, of Montrose, one of the former owners, in charge. The Superior and Bonanza King tunnel will be extended to cut veins exposed in surface workings and a force of miners will be employed. A compressor, an electric motor, and other mine equipment is awaiting completion of a bridge and clearing of the road to the Des Ouray group, where they will be installed by the Eurades Mining Co. A contract has been let for 100,000 ft. of lumber, and buildings are under construction. Miners have been engaged and development started.

TELLURIDE.—Ore shipments from Telluride for May totaled 90 cars: 50 cars of concentrate from the Smuggler mill and 40 cars from the Smuggler Union. The Valley View mill at Matterhorn is awaiting machinery. The Valley View Leasing Co. continues mining ore and has large tonnage held in reserve for the mill. Exploitation of the Chris Martinson group of claims near Placer-

ville for Vanadium is in progress and shipments will shortly be made to the plant of the American Vanadium company, at Vanadium, formerly owned by the Primos Chemical Company.

MICHIGAN

BOND ISSUE FOR HANCOCK CONSOLIDATED.

HOUGHTON.—Shareholders of the Hancock Consolidated company will meet on June 16, when it is expected they will authorize a bond issue of half a million dollars. This will cover the outstanding indebtedness and provide for future development work. The present operating corporation has conducted a rather complete development plan for the past year. The results, to date, are not satisfactory. Illustrating the amount of money that may be expended in search for profitable copper ground the Hancock Consolidated has 100,000 shares and the shareholders have paid in the \$25 par value, so that further capital must come from bond-sales or a re-organization of the company, which is working under the Michigan law. Hancock territory adjoins the Quincy and includes a block of St. Mary's Mineral Land Co. holdings. In Civil War days the mine was run by Edward Ryan and a considerable sum was expended in an effort to open a profitable producer. John D. Ryan, head of the Anaconda, Inspiration, and other properties, was largely instrumental in financing the present company, in an effort to assist the town of his youth with another industry. A year ago the company sold to the Quincy 140 acres of mineral land for \$251,523, thereby reducing its indebtedness.

The coal shortage in the Lake Superior district has hurt the smaller mines. The Franklin has been compelled to suspend all operations except the pumping and has just coal enough to do that for two weeks. Franklin has been opening some good looking territory north of the 39th level. The lateral shows material richer than 1% for 600 ft. Raises are started every 50 ft. and as far as they have gone are in good ore. To the south, on the same level, they have started to drift in good 'rock'. A winze on line with the shaft, which is in the foot-wall, will be started at once to provide ventilation and a place to drop the ore for hoisting purposes.

There is much interest in the continued opening of good ore in the Seneca. The shaft is nearing the 5th level and the raise to the 4th is well under way. On the 3rd and 4th levels the drifts continue in good ore, except for one bunch of poor quality that was met 230 ft. south on the 3rd. At this writing the miners are out of that again and in a grade of ore which is better than anything so far encountered in the Seneca development of the Kearsarge lode. Shipments to the mill include a small amount from the stock-pile but most of it comes from present underground developments. At the Gratiot, under option to the Seneca company, the 15th level drift south is in 260 ft. in fair looking material.

N. D. Hansen and L. Suverkrop are conducting a series of experiments at the Michigan College of Mines. They are working on a plan for the extraction of oil from stumpage on the upper peninsula. The oil is to be used

in the operation of the flotation process in local metallurgical plants. Soft wood stumpage is preferable but any will do. A chemical plant in Houghton already is planned. The stumpage has long been a serious agricultural problem.

Ahmeek is making a practice of replacing timber sets in the steeper parts of the mine with concrete sets. A year ago No. 4 shaft was shut-down for three months to permit extended operations of this nature. This shaft today is producing satisfactory ore in large quantity. Openings both north and south of the 20th and 21st levels are in particularly good ground. The 14th, 15th, 16th, 17th, and 18th levels now are being run only to the north.

MONTANA

WORK ON CORBIN AND BUTTE & BALLAKLAVA TO COMMENCE.

LIBBY.—The concentrator at the Lukens-Hazel mine is rapidly nearing completion. A crew of 32 men has already completed the housing for the mill, and the crusher is in place. Most of the equipment to be constructed on the ground has been completed.

HELENA.—The Sunset mine, situated about one mile west of the Free Coinage mine, is to be re-opened after lying dormant for a period of 25 years. The mine will be developed by a system of tunnels, one of which has already been driven 120 ft. The main orebody is expected to be reached within 30 ft. Samples taken from the property assay 55 oz. of silver per ton.

WICKES.—A two-foot vein of high-grade silver ore has been discovered in the Minah mine in tunnel No. 4, said to be the richest ore ever found in the district.

BASIN.—J. Asher Cowan, of Salt Lake City, has organized a company to exploit the Silver Trail property, which consists of five claims about three miles from the Basin. Three and one-half tons of ore from surface fissures averaged 112 oz. silver and \$9 in gold. Fourteen tons show an average assay of 36 oz. silver and \$3 in gold. A 200-ft. adit has already been driven.

BUTTE.—The Butte & Ballaklava property has passed under the control of the Silver Butte Mines Co., a Delaware corporation, which has also secured control of the Corbin-Copper King Co. at Corbin. The Butte & Ballaklava is situated on Butte hill and adjoins the Modoc and Modoc Extension on the south. The property has a 1600-ft. three-compartment shaft and a winze extending from the 1600 to the 1800-ft. level. Lack of funds has held back further development. There is an outstanding bond issue of 177,000 shares. Operations on both Corbin and Butte properties will soon begin.

Sinking has been resumed at the Butte & Plutus. The shaft will be extended to the 400-ft. level where a cross-cut will be started toward the Norwich vein. Unless water is reached at this point, the shaft will be continued to 600 ft., where the hoisting capacity of the present

plant will be reached. Three shifts are at work. The work already done on the claim has disclosed the Plutus lead on the 100-ft. level and in the shaft 150 ft. from the surface. John R. Moyle is president of the company.

The Mike Horse mine in the Big Blackfoot region is operated by the Sterling Mining & Milling Co. Tunnel No. 3 has been driven 800 ft., uncovering a good vein of milling ore. Tunnel No. 1 shows 6 ft. of ore, while in tunnel No. 2 excellent milling ore is being passed through. In three stopes on this level, the vein matter is from 6 to 12 ft. wide.

NEIHART.—The mines of this district are still down. In view of the sharp decline in the silver market, it is more than likely that no attempt will be made to resume operations at present.

Prior to the shut-down of the mines in this district, the Flohart Silver Mines Co. was making excellent progress in the development of the property. Air-lines



PRECIPITATING COPPER LEACHED FROM OLD DUMPS AT BUTTE

were being put at all points in the mine, much of the old timber work was being replaced, and all of the dangerous workings were being made safe. In tunnel No. 1 the Florence and Preston veins were opened and showed small streaks of ore.

NEVADA

CAVING SYSTEM ADOPTED BY UNITED COMSTOCK MINES CO.

VIRGINIA CITY.—The 2,200,000 tons of ore assaying \$10 to \$15 that is estimated to be blocked out from the surface to the 400-ft. level of the Imperial shaft of the United Comstock Mines Co. is to be mined by block-caving into branched chutes. The ore is in a block 500 ft. long and 75 to 100 ft. wide. A 10,000-ft. tunnel that will be used as a haulageway will be driven under this block, sub-levels will be opened from inclined raises and short branch or 'finger' raises will be driven from the main raises. Under-cutting and caving will be used to draw the ore by blasting between the sub-levels. This is a low-cost system used by the Inspiration at Miami, Ohio at Bingham, Nevada at Ely, and other companies

mining ore that breaks easily. The tunnel will be at a depth of 400 to 700 ft., as it is extended through the various claims and it will be driven rapidly by starting work simultaneously from four old shafts and the surface. The company, according to an official statement, has \$2,500,000 in the treasury and the plans include the erection of a 100-ton cyanide mill. The company controls a large acreage extending for 10,000 ft. along the Comstock lode and this will be prospected after work has been started in the Imperial. The companies taken over by the United Comstock are the Alpha, Imperial, Confidence, Challenge, Yellow Jacket, Crown Point, Belcher, Kentuck, Segregated Belcher, Globe, and Knickerbocker.

GOLDFIELD.—Details of the agreement for the organization of the Goldfield Deep Mines Co. of Nevada show that included in the consolidation is all the property, including cash, of the C. O. D., Merger, Atlanta, Blue Bull, Goldfield Combination, a defunct Washington corporation, and the Golconda, Mammoth, and Red Boy claims of the Goldfield Consolidated. The Combination is to be paid \$12,500, or a stockholder, instead of his share of this sum, may secure Deep Mines stock at one cent per share upon surrender of his stock to the Deep Mines. The C. O. D. has outstanding 2,941,200 shares, and no cash. C. O. D. stock may be exchanged share for share on payment of a one-cent assessment. The Consolidated, in exchange for the five claims, will receive 1,575,586 shares of Deep Mines and will pay out of the Consolidated treasury a one-cent assessment on this amount. The Merger has outstanding 5,966,000 shares and there is no cash in the treasury. Merger stock may be exchanged share for share on payment of one cent. The Atlanta has outstanding 4,288,156 shares and there is \$43,000 in the treasury. Atlanta stock may be exchanged share for share without the payment of an assessment. The Blue Bull has outstanding 1,500,000 shares and has \$14,000 in the treasury. Blue Bull stock also may be exchanged share for share without the payment of an assessment. The assessment will be delinquent not less than 40 days after the stockholders have been notified of the ratification of the contract with the new company. The Deep Mines is incorporated for 18,000,000 shares, par value five cents. The object of the organization of the Deep Mines is to provide funds for the sinking of a shaft to a possible depth of 3000 ft. and the exploration of the Consolidated-Florence vein where it enters the shale. Between Columbia and Victor mountains there is a depression in the shale and the present plan is to sink a shaft through the shale and into the granite at the lowest point in the depression, which, according to Corrin Barnes, geologist for the Deep Mines, may be the source of some of the porphyry flows forming the present surface. Some of the richest ore-shoots in the Consolidated-Florence vein have been found at the shale-latite contact in the Jumbo and Grizzly Bear. The Spearhead is prospecting this vein in the alaskite at a place where the latite and alaskite contact. Here the vein is composed of silicified alaskite,

quartz, and alunite, and low assays in gold are secured.

PIOCHE.—Shipping of lead-silver-gold ore has been started from the Hamburg, 10 miles from Pioche. The Hamburg is one of the oldest mines in the vicinity of Pioche and it is said that a total of \$200,000 worth of ore has been shipped at various times. The ore is coming from seams in low-grade material in drifts from a 130-ft. shaft and from old stopes. The ore is in beds in limestone and work was stopped several years ago when raises failed to find the continuation of a shoot thought to have been thrown upward by a fault. An inspection of the workings several months ago led to the opinion that the developed part of the vein is cut by two faults, one of which has been found, and the present work is being done to find and prospect beyond the second, where it is thought instead of the broken, low-grade ore now exposed, the vein will be found to have been little altered by the fault action. If there are good results from this work it is planned to resume sinking the shaft.

ROUND MOUNTAIN.—The report of the Fairview Round Mountain for the year ended December 31, 1919, shows there was mined and milled during the year 8692 tons of ore of a gross value of \$311,757. Bullion worth \$296,465 was produced with an extraction of 95.1%, or 2% more than in 1918. The gross value per ton of the ore treated was \$35.86 and the loss in tailing amounted to \$1.76, leaving a net value of \$34.10. The operating cost, exclusive of depreciation and depletion, was \$119.811, or \$13.78 per ton. Of this, \$22,023, or \$2.53 per ton, was for milling. Dividends amounting to \$134,665 were paid during the year.

MINA.—The station on the seventh level of the Simon Silver-Lead mine has been timbered; the skip-pocket, 20 ft. below the station, has been finished; the pumping station completed, and cross-cutting started to cut the downward extension of the orebodies developed on the fourth, fifth, and sixth levels. The cross-cut has entered heavily mineralized and highly silicified limestone entered heretofore in practically all drifts and cross-cuts before the ore was found. Ore has been reached in cross-cut No. 613 driven on the sixth level south-westerly to find the faulted segment of the ore thrown off by the west fault. A streak about one foot wide assayed 99.6 oz. silver, 7.4% lead, 10.5% zinc, and 80c. in gold. A check sample on the silver content returned 100.2 oz. silver and another sampling returned 66.7 oz. silver.

The framework for the new cyanide mill in course of erection by the Olympic Mines Co., capacity to be 65 tons per day, to use a counter-current decantation cyaniding process, has been completed. Two Fairbanks-Morse type 'Y' vertical-cylinder semi-Diesel engines have been bought. Machinery is being hauled from Mina to the property. The former mill was totally destroyed by fire last spring. The company recently bought from J. P. Nelson and associates the Loo mine following an examination by Fred Searles, geologist. According to an announcement by the management a large tonnage of gold ore of commercial grade has been developed in the Olympic and the Loo mines.

UTAH

PROGRESS IN CONSTRUCTION WORK ON THE CONCENTRATOR OF THE TINTIC STANDARD COMPANY.

ALTA.—Development and exploration of the orebody on the 100-ft. level of the Emma mine are proceeding steadily, according to George H. Dern, general manager. A number of well-defined faults, while not serious, have made the prospecting more difficult. At present, the work farthest along the strike of the bedding shows the orebody to be less disturbed. The important fact brought out by the work in the new orebody is that the ore occurs as a replacement of the Emma or Flagstaff limestone. Special importance is attached to this fact, because it is the same formation that contained the bonanza orebodies that were mined in the Flagstaff, Vallejo, and Emma mines in the '70s. The ore, as developed at present, extends more than 85 ft. from the point where it was cut at the Montezuma fault, has a width of approximately 30 ft., and is about seven feet thick. Approximately 1000 tons of ore is stored in the bins, on dumps, and underground awaiting shipment. The beginning of shipping will depend on the rapidity with which the snow melts and the wagon-roads get in such shape as to permit hauling to the railroad.

Suit to recover \$45,000, triple the value of ore alleged to have been secretly extracted from the Columbus No. 4 lode mining claim, was filed recently in the Third District court at Salt Lake City by the Wasatch Mines Co. against the Cabin Mining Co. The complaint alleges that the defendants began secretly taking out ore from the mentioned lode in July 1917, and continued to do so until mineral to the value of \$15,000 was taken. The Court is asked to give judgment in accord with the State mining law for thrice the value of the ore alleged to have been extracted from the plaintiff's property.

The Board of Directors of the Tar Baby Mining Co. re-elected J. Martin Matsen as president and general manager at the annual meeting held on June 7. Mr. Matsen reported that 800 ft. of work had been done during the fiscal year ended June 1, 1920, the last 410 ft. of which was in the Cardiff limé. This stratum is from 425 to 465 ft. thick. The lime is highly mineralized with pyrite and iron carbonate.

BINGHAM.—Practically all of the underground mining companies in this camp have adopted the plan of letting their work out under contract, and the majority of the superintendents are pleased with this system. One of the first companies to start this method was the Utah-Apex. Under this plan, the men get paid for the amount of work they do, and if they feel disposed to work nine or ten hours instead of a straight eight-hour shift, it is their privilege to do so. There is still a considerable shortage of labor, but lately a number of mining students and even local high-school boys have been going to work in the mines for the summer vacation.

TECOMA.—Work is progressing at the Tecoma Consolidated property, 2½ miles from this station. Ore-bins to furnish storage have been completed at the mine and loading station. The road has been put in excellent shape

for hauling by automobile trucks, and all details have been arranged so that capacity shipments may be started as soon as the plant of the Utah Zinc Co. at Murray is completed. This plant at present is 80% finished, and operations will be started about July 15. The main face of the Woodward tunnel is being driven to tap at depth the zinc orebody blocked out in the old workings by the Utah Zinc Co., and to prospect at depth all of the important fissures which form a network in the formation. At a distance of 675 ft. from the portal, a raise is being put up to furnish an outlet for the ore above. At the same point a drift is being driven north-west on a fissure



LOUISE MINE AT ALTA, UTAH

in which a good showing of silver-lead ore was cut by the main tunnel. Raising has been started at a point 850 ft. from the portal to furnish another connection with the upper workings.

PARK CITY.—An important strike has been made at the Park-Utah mine. In a cross-cut some three feet of good shipping ore is being followed, which has every appearance of being a persistent body. Streaks from 8 to 15 in., carrying 90 oz. of silver, are in the vein, with large quantities of milling ore. Ore shipments from this property will begin during June, as the Ontario tunnel is now being put in shape so that the ore can be taken to the shaft, hoisted to the 600-ft. level, and conveyed to the Ontario loading station.

EUREKA.—The volume of production at the majority of the mines here is reduced, owing to the fact that the

smelters have asked the operators to cut down their shipments to 50% of normal. During the week ended June 5, a total of 137 cars of ore was shipped, as against 139 the previous week. The Chief Consolidated shipped 36 cars; Dragon, 23; Tintic Standard, 20; Grand Central, 8; Iron Blossom, 7; Iron King, 7; Mammoth, 6; Eagle & Blue Bell, 5; Victoria, 5; Centennial-Eureka, 4; Seranton, 4; Gemini, 3; Swansea, 2; Colorado, 2; Bullion Beck, 2; Sunbeam, Alaska, and Ridge & Valley, each 1.

Rapid progress is being made by the Tintic Standard Mining Co. in the construction of its new concentrator at Warm creek. With a force of more than 200 men at work, it is expected that the mill will be ready by early fall. A spur-track, nearly a mile long, leads from the main track of the Denver & Rio Grande railroad to the mill. The boarding and bunk-houses, modern in every particular, are about completed. Two large transformers are now being placed in position on the hillside and it will be a matter of only a short time until electric power will be available for operation of the tram, now under construction, to elevate supplies to the mill-site. The mill will eventually have a capacity of 1000 tons per day; a large tank, of California redwood, is being constructed above the mill-site, to assure an ample water-supply.

Officials of the Eureka Hill Mining Co. have made arrangements to lease a large block of ground to a Salt Lake company which has been organized by L. E. Riter and associates. The ground to be covered by the lease is at the south end of the Eureka Hill holdings, adjoining the Centennial-Eureka property. The exploration work will be handled through the Centennial-Eureka workings. Some of the best ore that has ever been produced in this district came from the south end of the Eureka Hill tract, and there is a possibility of the lessees opening valuable deposits. This part of the Eureka Hill's property has been inactive for some years, owing to the dismantling of the hoisting plant.

WISCONSIN

REVIEW FOR MAY.

The delays, following the railway strike, incident to the marketing of ore were brought out forcibly in the case of the Block-House Mining Co., of Platteville. Some high-grade zinc ore sold to the Mineral Point Zinc Co. was a month on a haul considerably under 300 miles. The congestion in the East reached such proportions that a solid train load of slab-zinc consigned to Eastern consumers was lost track of entirely. High-grade refinery product was bid-in at \$53 per ton, the first week in May. By the middle of the month such ore as had been sold on contract had reached smelters and no quotations were made public. Diligent inquiry found a shipment of high-grade prime Western ore the third week, the base offering on which was \$49.25 per ton. The closing days of the month found high-grade shipments of zinc ore on a range of prices running from \$47 to \$49 per ton; second grades, \$43.50 to \$45. At the latter price one of

the leading operators of the field declared production could not be maintained at this level and that no attempt would be made to reach market with ore available for delivery. Low-grade zinc-ore producers selling on open-market quotations met with little or no consideration the greater part of the month. Offerings fell to a point no longer inviting and great stocks of milled concentrate accumulated at all points, the total in the field probably exceeding 10,000 tons.

Lead-ore producers suffered in like manner, although prices remained firmer and demand for lead ore continued steady and good. Starting at \$110, the price broke early in the month and receded to \$100 per ton, base 80% metal content. Production, contingent upon the volume of wet milling, in this field, was light and the reserve in the field was trimmed down to about 500 tons. Shipments for the month were fair, the idea gaining ground that less than \$100 would be paid and that it would not be profitable to hold longer. While prices remain high many small firms diligently seek sub-leases on mining lands to root over shallow diggings and surface workings but no appreciable quantity of lead ore has been obtained in this manner. The ore sold during May came from the large zinc-producing mines and the supply of lead ore from this field will be obtained in this manner no matter what the status of the lead-ore markets. At times some little competition seemed to develop among buyers, but for the greater part of the month the Federal Lead Co. seemed to set the pace on bids, with the American Zinc & Lead Smelting Co. a close contender.

The production of carbonate zinc ore, in the northern part of the field, received impetus through operations of small independent concerns selling in the open market, the range of prices going from \$35 to \$40 per ton, base 40% zinc assays. The New Jersey Zinc Co., which has been mining this class of ore and carrying big equipment, seems to have lost prestige and shipments are comparatively light from the mines of this company. Such iron pyrite as was marketed during the month came from the electro-static separating plant of the Zinc Concentrating Co., of Cuba City, all sold to the General Chemical Co. The Grasselli Chemical Co., which for many years offered a fair outlet for this class of ore, has withdrawn from the local market entirely. Thousands of tons of pyritic concentrate is held in the field for which apparently no market exists. At one time from 20,000 to 30,000 tons of pyrite was marketed annually in this field.

The foreign miner is not popular in this region, and is being replaced in considerable number with blacks from the south. Where tractable and inclined to refrain from agitation the foreign miner is permitted to go along. Negro miners are making good; in fact five shovelers at the Graham mine have a record of 35 to 40 tons, of mine head, on each 9-hour shift and have earned as high as \$12 per day. Employers state that the black miner is American at heart and without liquor develops into a good workman quickly.

Deliveries of zinc ore and lead ore, from mines to sepa-

rating-plants in this district, and from mines to smelters direct, were made by districts for May as shown here:

District	Zinc, lb.	Lead, lb.
Benton	6,168,000	422,000
Galena	3,254,000	160,000
Livingston	2,222,000	80,000
Cuba City	2,184,000	210,000
Highland	1,020,000	160,000
Hazel Green	724,000	.....
Day Siding	422,000	160,000
Millbrig	390,000	82,000
Linden	314,000	.....
Shullsburg	276,000	.....
Total	16,974,000	1,274,000

Deliveries of high-grade blende from electro-magnetic separating plants to smelters, were made for May by the following companies:

Company	Lb.
Mineral Point Zinc Co.....	4,042,000
Wisconsin Zinc Roasters	2,894,000
Zinc Concentrating Co.....	610,000
National Ore Separators	532,000
Total	8,078,000

BRITISH COLUMBIA

ALASKAN-CANADIAN BOUNDARY TO BE RE-MARKED.

STEWART.—The Patricia, Magee, and Montana groups of mineral claims, situated on the Marmot river, are to be developed during the summer. On the Patricia a four-foot vein of good ore has been opened, samples from which have given returns from \$15 to \$35 in gold, and as high as \$62 in silver.

J. D. Craig, an engineer for the Dominion government, has taken charge of the Canadian party, whose duty it will be to co-operate with United States surveyors in the establishment of a clearer definition of the Canadian-Alaskan boundary. Stone cairns on the mountains, bronze monuments, and a 20-ft. lane through the forest will mark the boundary by the time the engineers have finished their season's work. Commenting on his task Mr. Craig said: "The wisdom of marking the boundary some sixteen years ago—a marking which has since become more or less obliterated—is now apparent. As it happens about 90% of the silver recently discovered has been on the Canadian side. If the survey had been delayed it might have made the settlement of the line more difficult to agree upon." A neutral strip of 60 ft. on either side of the boundary is to be reserved, as is the custom on the whole 5000 miles of Alaskan and U. S. boundary, except where titles to the strip had previously passed out of the hands of the Government. Mr. Craig does not think this will mean that the strip will be withheld from mineral development, but that in the case of the location of mineral special leases will have to be obtained from Ottawa or Washington.

ALICE ARM.—The snow is rapidly disappearing in this district and mining is becoming active. The Dolly Varden mine again is in full operation and ore shipments are being received at tide-water. The La Rose property is to be developed further and a force of men has been

put to work. The Moose prospect also is to be opened up and the McLennan Silver Mines Ltd. already has started work on the Royal group adjoining the Dolly Varden. In the course of the last few weeks a great many miners and prospectors have arrived and as the snow recedes prospectors and miners will make their way up both the Kitsault and the Illiance rivers.

KAMLOOPS. It begins to look as though the Stump Lake mine of the Donohoe Mines Corporation is to produce within a short time. Machinery has been ordered for a modern concentrating plant; the foundations for which are now being constructed. The plant, it is hoped, will be ready for operation in three or four months at the outside. It will have a capacity of 50 tons per day. The ore of the Donohoe mine is principally silver bearing but contains besides gold, lead, and copper, the metal content varying in value from \$20 to \$600. The prop-



SIDE-DUMP ORE-CARS AT BRITANNIA MINE, B. C.

erty recently was inspected by William J. Shedwick, Jr., of the Kennecott Copper Corporation, and Lewis A. Levensaler and Francis N. Myers, all of whom are mining engineers.

NELSON.—The Nelson Mining & Development Co., which is interested in a number of properties in the Lardeau and Sandon district, is preparing for development work. The Whitewater and Comstock groups on Cascade creek, Lardeau, are to be opened, and, to facilitate this, the construction of a nine-mile wagon-road is planned. On the Comstock leases there is a good mill-site, and the erection of a mill is being considered. Some good silver-lead veins have been uncovered on the Zineton property near Sandon and, in addition to high-grade ore, a considerable quantity of good milling ore has been exposed. Clarence A. Marsh, secretary of the company, also is interested in the Gold Cure mine, situated on the South Fork of Kaslo, and it is his intention to start development here immediately. Ore rich in silver and lead already is in evidence and if the results of further work are satisfactory the idea is to build a concentration and flotation plant having an initial capacity of 50 tons per day.

TRAIL, B. C.—Receipts at the Trail smelter of the Consolidated Mining & Smelting Company of Canada for the week ended May 31 were 6832 tons, of which 67

was concentrate. One of the noteworthy independent shippers was the Bluebell, of Riondell, which contributed 180 tons, thus indicating that this mine, for a time inactive because of lack of water-power, has resumed operation. Other shippers, apart from the company's properties, were Electric Point, Boundary, Washington, 196 tons; Florence, Princess Creek, 67 tons; Josie, Rossland, 170 tons; North Star, Kimberley, 181 tons; No. 1 mine, Ainsworth, 127 tons; and the Tam O'Shanter, Riondell, 56 tons. The Sullivan mine, Kimberley, evidently is getting back to normal, having shipped 5367 tons of zinc ore and 296 tons of lead ore during the week. The total amount of ore to be received at the smelter up to the present year is 110,298 tons.

VICTORIA.—According to report, Alder island, one of the smaller of the Queen Charlotte group, consists of one large deposit of metallic arsenic. The two or three claims staked cover the entire island and samples taken indiscriminately give returns running from 18% to 24% arsenic, while the locator states that it is possible to obtain specimens of almost pure mineral. This is interesting because it appears to be the first such deposit of which there is record in British Columbia, although for years arsenic has been produced as a by-product from the arseno-pyrite ores of the Hedley Gold Mining Company.

ONTARIO

REPORT OF DOME MINES, LTD.

TORONTO.—At the annual meeting of the Mining Corporation of Canada on June 5 it was announced that the company is associated with W. B. Thompson & Co., of New York, in the option on the Flin Flon copper mine in North-Western Manitoba. The property is being explored by the sinking of shafts and drifting on the vein, with a view to confirming the results of diamond-drilling, which indicated 20,000,000 to 30,000,000 tons of copper ore. The option runs until next March, but development work may justify decisive action before that time. The amount of capital required to establish the enterprise is estimated at from \$8,000,000 to \$10,000,000. The shareholders were informed that although the corporation has done much exploration in various parts of the world, it is now intended to confine its operations largely to this continent.

PORCUPINE.—In addition to increasing the minimum wage-rate the leading companies have classified their labor, giving a premium to skilled workers. These changes have done much to stabilize the labor situation and allay unrest and the tendency to wander from camp to camp.

The annual report of the Dome Mines for the year ended March 31 shows the total production to be \$1,773,374; operation and maintenance expenses were \$930,762, leaving net earnings of \$842,612, which, with revenue from other sources amounting to \$109,372, gives a total net profit of \$951,984. Deductions amounting to \$600,170 were made, chiefly for depletion of properties, depreciation, and replacement, leaving a net surplus for

the year of \$351,814. This is regarded as a highly favorable showing in view of the fact that the mill was only in operation for 10½ months and that production was considerably curtailed by labor shortage. The total quantity of ore treated was 270,080 tons, the average yield being \$6.506 per ton, the recovery being 94.295%. Regarding ore-reserves the report is somewhat conservative, avoiding any specific statement, but intimating that the reserves are sufficient to enable the plant to continue operating to capacity for three or four years. As regards development work on the Dome Extension reference is made to various orebodies found with the ore valued at from \$4.45 to \$4.95 per ton.

KIRKLAND LAKE.—During April the Lake Shore produced bullion to the amount of \$35,388 from the treatment of 1860 tons of ore, mill-heads, being below the former average, amounting to \$19.50 per ton. At the Bidgood the vein, which was 8 ft. wide on the surface, has widened to 15 ft. at the 100-ft. level. The shaft is down 140 ft. The Moffat-Hall Gold Mines, which owns a group of claims near the Bidgood, has erected buildings and has a force engaged in stripping and trenching work.

COBALT.—Announcement is made that the Bailey Silver Mines will send out its first shipment of ore soon, and that sufficient ore is in sight to assure regular shipments for some time, 23,000 tons of fairly high-grade ore being already blocked out. Several veins only await development to bring them to a point of productivity. It is over five years since the Bailey was worked, curtailment having been caused by litigation that began in 1915 and only ended this year.

The return of foreign-born laborers to their former homes in Middle and Eastern Europe appears to have about run its course, and has left a steadier class of workmen at the mines. It has increased the percentage of British and American born citizens in all the leading mining camps of Northern Ontario. That new immigrants from the British Isles are destined to further add to this favorable situation is indicated in a statement by a leading mine manager that he noted an encouraging sprinkling of these new recruits to the ranks of Canadian labor. A further favorable sign is statistics from official records which show an increasing number of applications from former citizens of various European countries, who are now seeking Canadian naturalization.

At the Peterson Lake, a shipment of high-grade ore is being assembled, and is estimated to contain about 50,000 oz. of silver. The re-treatment of sand tailing by contract in the mill of the Dominion Reduction Co. will not commence before the end of July. At the annual meeting, the following directors were elected: W. A. Lamport, president; J. E. Carter, vice-president; and E. Barelman, W. H. G. Browne, A. G. Cumming, D. E. Kennedy, C. A. McLean, A. H. B. Moore, C. M. Nickel, and P. M. Goff, directors. The Crown Reserve Mining Co. has acquired an option on the Hylands-Offor group of claims, situated in the township of Whitney in the Porcupine district. It is proposed to explore the property by using diamond-drills.



OPENING FOR GOVERNMENT METALLURGIST

A vacancy in the Bureau of Mines for services in the field, at \$3600 to \$4000 a year, is announced. The duties of the appointee will be to conduct investigations at one of the mining experiment stations authorized by the act of Congress of March 3, 1915, and established July 1, 1916; to supervise investigation and to disseminate information with a view to improving conditions in the mining, quarrying, metallurgical, and other mineral industries in the district served by the station, especially with a view to preventing unnecessary waste of resources and otherwise contributing to the advancement of these industries. Applicants must have graduated in mining engineering or metallurgy from a college or university of recognized standing and have had at least five years of responsible experience in such work, of which at least two years must have been along metallurgical lines. Applicants must not have reached their fiftieth birthday on the date of the examination. Age limits do not apply to persons entitled to preference because of military or naval service. Applicants should at once apply for Form 2118, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Cal.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

ARIZONA

Prescott.—The New Cornelia Copper Co. recently fired one of its huge blasts. The company late last year completed the lay-out of powder chambers and connecting tunnels in its hill No. 3, the length of underground excavations being 661 ft. This was loaded with 80,000 lb. of Trojan nitro-starch powder and fired by an electric current of 110 volts. The cost of the blast for labor and supplies was \$15,305, which with the cost of drifting and excavating made a total of \$17,720. Approximately 300,000 tons of ore was loosened by the blast, the cost averaging about 6c. per ton.

MISSOURI

Joplin.—Hand-jigs have returned to the Oklahoma-Kansas mining district. Scores of these primitive machines are being used about the field to a great advantage, especially in developing properties to the point where it is known definitely that they will justify the expenditure of money for a concentrating plant. Some of the best mines in the district have been developed by the hand-jig. Among them are the Montreal, the Empire, the LaSalle, and the Douthat. The Coalgate was originally operated with hand-jigs, then steam-jigs were built in the open and operated for a while before a building was erected over them; then it was thought best to convert the cheap plant into a better one, which is now being done. Among those which are being operated now are the McConnell, the Powers, and the Barker-Howell, south of Baxter; the Sedalia, south of Hockerville; the High Grade at Quapaw; and the Reserve, west of Hockerville.

A large number of mines near Aurora continue at work and others will resume operations after repairs are made to machinery and the water is pumped from the mines.—**Hunter & Co.** have completed the cleaning up of the ore taken from the Decker-McCrellias Co. mine, which was treated at the Louisville mill, and will stop milling work until a new shaft is sunk. Two cars of high-grade silicate were sold last week.—**Cutright & Co.** have been pumping water and have lowered it to 75 ft. When they get down to 87 ft. they will be able to work in the drift. The mill machinery will be in shape to start in about 10 days and it is the intention to start mining then.—**Mill & Co.** are awaiting the arrival of repairs for their engine, which was broken recently, to resume operations at the mill. They have taken out a quantity of rich silicate while waiting for the engine repairs.

Miners will soon be leaving in large numbers for the harvest fields. Mining companies will then be competing with one another for the scant labor supply. It will be a most opportune time to shut-down. A plan suggested by one operator is to shut-down all mines during the wheat harvest and over the Fourth of July, say from June 15 to July 15. This, he says, would get rid of the surplus stocks of ore and restore a fair market price.

A large cave, lined with great chunks of almost pure lead and zinc, extending more than 100 ft. in length and about 30 ft. in width, has been discovered in the Red Skin mine. A large slab on a roof of a drift was shot down, and Fred Bouldin, manager of the mine, noticed an opening. He obtained a ladder, climbed up, and found the big chamber. He took to Miami several specimens of ore taken from the cave and said that it was filled to a depth of several feet on all sides with almost pure lead and zinc.

OREGON

Holland.—The old Cowen quartz mine near here has been acquired by A. C. Stewart and associates. It is reported that the new owners will erect a modern reduction plant on the property. The Cowan mine was located in 1880 and was worked in a crude way, the ore being hauled ten miles to an arrastra. Considerable lower-grade ore is still available.

Medford.—The Bolen Creek Mining Co. has filed an application with the State Engineer for a water-right on Sucker creek sufficient to develop 90 hp. for operating its mine equipment in the Waldo district.—The War Eagle Mining Co., in the Gold Hill district, has a crew doing further development on its mercury deposits. The company is operating two 12-pipe mercury-furnaces on ore averaging 17% and better. It proposes to add a 25-ton furnace this season.

WASHINGTON

Stevens County.—The Silver Trail company reports a large body of silver-lead ore on the 700-ft. level in the Bonanza mine. A contract for hauling to the Northport smelter will be let soon.—The new compressor arrived at the Aichan Bee mine several days ago and will be put in operation at once. The tunnel is in 462 ft. It has gone through 12 ft. of blue lime and has now broken through the iron crust that usually has been found over good veins.

WARREN G. HARDING

Warren G. Harding, who has been nominated as candidate for President by the Republican convention, has always been a resident of Ohio, which State he has represented as United States Senator since 1914. In private business life he is publisher of the 'Marion Star'. He was born on a farm near the village of Bloomington Grove, Morrow county, Ohio, November 2, 1865, the eldest of eight children. His father, George T. Harding, was a country doctor, whose forebears came from Scotland. Before going to Ohio the Hardings were residents of Pennsylvania, where some of them were massacred by Indians. Others fought in the Revolutionary war. The mother of Warren, Phoebe Dickerson Harding, was descended from an old-time Holland-Dutch family, the Van Kirks. In his youth Warren Harding lived the life of a farmer boy, attending the village school until 14 years of age, when he entered Ohio Central College at Iberia, from which he was graduated. As editor of the college paper he first displayed talent for journalism. He was obliged to stop school now and then and earn the money with which to pursue his college course. At one time he cut corn, at another painted barns, and at still another drove a team and helped to grade the roadbed of a new railway. At 17 he taught a district school and played a horn in the village brass-band. At odd times he worked in the village printing-office, in time becoming an expert typesetter, and later a linotype operator. He is a practical pressman and a job-printer, and as a 'make-up man' is said to have few equals. The luck piece he has carried as a Senator is the old printer's rule he used when he was sticking type.

In 1884 Dr. Harding moved his family to Marion. A short time afterward the father purchased for Warren Harding the 'Star', then a small paper. On the paper Warren Harding performed every function from 'devil' to managing editor. In all the years the Senator has owned it there has never been a strike or a threatened one. Senator Harding is closely identified with many other large business enterprises in Marion and other parts of the State. He is director of a bank and several large manufacturing plants, and is a trustee of the Trinity Baptist Church. Harding has twice represented the thirteenth senatorial district of Ohio in the State Legislature and served one term as Lieutenant-Governor. At the 1914 election, Mr. Harding was elected United States Senator by a majority of more than 100,000, running 73,000 ahead of the next highest on the ticket. In the Senate he is a member of the Committee on Foreign Relations. Senator Harding married Miss Florence Kling in 1891.

FLOTATION LITIGATION

The flotation litigation, involving a number of copper companies and the Butte & Superior Mining Co., promises to be a long drawn out affair. A new step taken by the Miami Copper Co. against the Minerals Separation company will probably delay materially the litigation between those two companies. Minerals Separation had brought contempt proceedings against Miami for alleged continued infringement of patents in defiance of injunction. Miami countered with a request that the original suit be re-opened on the grounds of alleged new evidence. The United States Circuit Court of Appeals at Philadelphia in determining this request will have to decide whether the so-called new evidence would have received favorable consideration had it been presented at the time of the original trial. Hearing on the contempt proceedings has been set for June 15 at Philadelphia. Pending these hearings the work of taking an accounting of Miami's operations during the past few years has been suspended. In the meantime hearings set for preliminary steps in the Nevada Consolidated and Magma cases at Portland have been postponed until mid-July.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

Gerald H. Hatton is at Dayton, Nevada.

A. J. Eveland is leaving Mexico for Boston.

C. S. Waite has moved to Reno from San Francisco.

A. G. McGregor, of Warren, Arizona, is in New York.

V. H. Wilhelm, recently in Mexico, is now at Stewart, B. C.

P. L. Chase, of Denver, is examining mines at Lake City, Colorado.

G. S. Eldridge, of Vancouver, B. C., was in San Francisco this week.

E. F. Davis, of Salt Lake City, has moved to Albuquerque, New Mexico.

F. H. Probert is delivering a series of lectures on mining at Yale university.

C. F. Sturvenant has returned from South America and is now at Salt Lake City.

D. J. Richards has returned from Kennecott, Alaska, to Buena Vista, Colorado.

Grenville A. Collins has resumed consulting mining practice at 2006 L. C. Smith Bdg., Seattle.

J. C. Pickering has opened an office as consulting mining engineer at Avenida Juarez No. 83, Mexico City.

Roscoe Edyvean, of Denver, Colorado, is now at the Wilshire Bishop Creek mine, near Bishop, California.

Samuel W. Cohen of Montreal has recently purchased the Poulin asbestos mine at East Broughton, Montreal.

Alfred Hurst has been appointed superintendent for the Angels Camp Deep Mining Co., at Angels, California.

Alfred James, who has been on a visit to Mexico, was at Laredo on June 16 and, it is hoped, will visit San Francisco.

Errol MacBoyle, president of the Durango Silver Mines Co., has left San Francisco to inspect the company's properties in Mexico.

G. H. Clevenger, consulting metallurgist to the U. S. Smelting, Refining & Mining Co., is on his way back to Boston from California.

James S. Wroth, of New York, has sailed for South America, where he will be engaged on professional business for about a year in Peru, Chile, and Bolivia.

James O. Greenan has gone to Berkeley, California, where he expects to be for some time. Following his resignation as superintendent of the Fagan Con. Silver mine, at Simon, Nevada, E. W. King was appointed his successor.

R. G. McConnell, for many years deputy minister of the Canadian Department of Mines, has been superannuated at his own request, and Charles Camsell, superintendent of the British Columbia branch office of the Geological Survey since its establishment, two years ago, has been appointed in his place.

James F. Parks, superintendent for the Plymouth Consolidated Gold Mines in Amador county, California, and one of the most esteemed mining men in California, died on Wednesday, June 9, at the age of 38 years, in the Sisters Hospital at Sacramento, following an operation for appendicitis. Interment took place on Friday at Plymouth. He was the son of the late James F. Parks, formerly superintendent for the Kennedy Mining Co., and was a brother of Mrs. F. W. Bradley and Mrs. John F. Davis. The Parks family has been associated with the history of the Mother Lode in Amador county since its discovery. Not only the Plymouth Consolidated Gold Mines, but the mining community of California suffers a loss. Deep regret will be felt that a man so capable and honorable should have been taken while in the prime of manhood and effectiveness.

THE METAL MARKET



METAL PRICES

San Francisco, June 15

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10
Copper, electrolytic, cents per pound.....	19
Lead, pig, cents per pound.....	8.75-9.75
Platinum, pure, per ounce.....	\$85
Platinum, 10% iridium, per ounce.....	\$118
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	9.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

June 14—Copper is inactive and firm. Lead is quiet and steady. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
June 8.....	84.00	48.37	May 3.....	112.08	65.14
" 9.....	81.00	45.62	" 10.....	105.50	62.39
" 10.....	87.00	48.37	" 17.....	101.21	58.50
" 11.....	92.00	51.25	" 24.....	100.12	58.52
" 12.....	90.00	50.25	" 31.....	101.17	58.87
" 13 Sunday.....			June 7.....	98.23	58.87
" 14.....	85.00	44.25	" 14.....	86.00	48.02
Monthly averages					
Jan.....	1918 88.72	1919 101.12	1920 132.77	July.....	99.62 106.36
Feb.....	85.79	101.12	131.27	Aug.....	100.31 111.35
Mch.....	88.11	101.12	125.70	Sept.....	101.12 113.92
Apr.....	95.35	101.12	119.56	Oct.....	101.12 119.10
May.....	99.50	107.23	102.89	Nov.....	101.12 127.57
June.....	99.50	110.50		Dec.....	101.12 131.92

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	New York cents	Average week ending	Cents
June 8.....	19.00	May 3.....	19.25
" 9.....	19.00	" 10.....	19.12
" 10.....	19.00	" 17.....	19.00
" 11.....	19.00	" 24.....	19.00
" 12.....	19.00	" 31.....	19.00
" 13 Sunday.....		June 7.....	19.00
" 14.....	19.00	" 14.....	19.00
Monthly averages			
Jan.....	1918 23.50	1919 20.43	1920 19.25
Feb.....	23.50	17.34	19.05
Mch.....	23.50	15.05	18.49
Apr.....	23.50	15.23	19.23
May.....	23.50	15.91	19.05
June.....	23.50	17.53	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	New York cents	Average week ending	Cents
June 8.....	8.75	May 3.....	8.75
" 9.....	8.75	" 10.....	8.62
" 10.....	8.75	" 17.....	8.50
" 11.....	8.75	" 24.....	8.50
" 12.....	8.75	" 31.....	8.50
" 13 Sunday.....		June 7.....	8.68
" 14.....	8.75	" 14.....	8.75
Monthly averages			
Jan.....	1918 6.85	1919 5.60	1920 8.65
Feb.....	7.07	5.13	8.88
Mch.....	7.26	5.24	9.22
Apr.....	6.99	5.05	8.78
May.....	6.88	5.04	8.55
June.....	7.59	5.32	

TIN

Prices in New York, in cents per pound.

Date	New York cents	Average week ending	Cents
June 8.....	8.75	May 3.....	8.75
" 9.....	8.75	" 10.....	8.62
" 10.....	8.75	" 17.....	8.50
" 11.....	8.75	" 24.....	8.50
" 12.....	8.75	" 31.....	8.50
" 13 Sunday.....		June 7.....	8.68
" 14.....	8.75	" 14.....	8.75
Monthly averages			
Jan.....	1918 85.13	1919 71.50	1920 62.74
Feb.....	85.00	72.44	59.97
Mch.....	85.00	72.50	61.92
Apr.....	88.53	72.50	62.12
May.....	100.01	72.50	54.99
June.....	91.00	71.83	

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	New York cents	Average week ending	Cents
June 8.....	8.10	May 3.....	8.32
" 9.....	8.05	" 10.....	8.21
" 10.....	8.00	" 17.....	8.11
" 11.....	7.95	" 24.....	7.94
" 12.....	7.95	" 31.....	7.92
" 13 Sunday.....		June 7.....	8.02
" 14.....	7.95	" 14.....	8.00
Monthly averages			
Jan.....	1918 7.78	1919 7.44	1920 9.56
Feb.....	7.97	6.71	9.15
Mch.....	7.67	6.53	8.93
Apr.....	7.04	6.49	8.76
May.....	7.92	6.43	8.07
June.....	7.92	6.91	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	New York dollars	Average week ending	Dollars
June 18.....	85.00	June 1.....	86.00
May 25.....	80.00	" 8.....	90.00
" 25.....	80.00	" 15.....	85.00
Monthly averages			
Jan.....	1918 128.06	1919 103.75	1920 89.00
Feb.....	118.00	90.00	81.00
Mch.....	112.00	72.80	87.00
Apr.....	115.00	73.12	100.00
May.....	110.00	84.80	87.00
June.....	112.00	94.40	

THE BANKING CONSORTIUM FOR CHINA

Thomas W. Lamont of J. P. Morgan & Co. is quoted as follows: "In October, 1918, the United States proposed to Great Britain, France, and Japan that they support banking groups in forming of a new consortium for assisting China in the development of public enterprises. The United States proposed that the new consortium have a wider scope than the old one, that it be a free and full partnership, and that operations or concessions on which substantial progress had not been made should be pooled with the consortium, whose operations would prevent future setting up of special spheres of influence. The United States laid stress on this latter point as doing away with international jealousies and helping preserve the integrity of China.

"It was not to be the aim of the consortium to concern itself with general enterprises, but rather only basic enterprises such as development of transportation, highways, currency, etc., that would establish a sounder economic condition. Its operations should deal primarily with loans to the Chinese republic or its provinces. These proposals were approved by the other governments, and the banking groups formed directed their representatives to meet for organization in Paris in May, 1919. These represented a much larger banking group than in the old consortium. The American banking group had been expanded from the former 5 to 31 member banks.

"The governments of Great Britain, France, and United States approved without change the agreement reached, but Japan qualified its approval by reserving portions of Manchuria and Mongolia from the scope of the consortium. I was requested by American group and the state department to visit Japan and China and report on the whole situation. In Japan I ascertained that misapprehension existed as to the objects of the consortium; but after conferences I found the Japanese bankers unanimous in the desire to enter the consortium without reservation, and they expected formal approval from their government. If Japan should continue to withhold its assent, it would be the chief loser by its failure to become a member.

"In China I have had important discussions with bankers and men of affairs, and can lay down certain principles which the American group will advocate and the consortium will follow. It will undertake operations only when the people of China desire. If China desires its assistance, it will be for China to render cordial co-operation. We have to see that any loans are for constructive and not wasteful purposes, and some proper system of audit must be mutually worked out to make certain the proper application of funds. Such audit plan does not interfere with China's right to govern her own affairs.

"The consortium's second responsibility is to its investors at home, to see that their investments are designed and expended for constructive purposes. The American group—and I am sure the other banking groups—have strong faith in the resources, industry, and integrity of the Chinese people. They believe there exists in China a large amount of wealth, liquid as well as latent, which it is their confident belief needs only to be mobilized."

MONEY AND EXCHANGE

Foreign quotations on June 15 are as follows:

Sterling, dollars: Cable.....	3.94½
Demand.....	3.95½
Francs, cents: Cable.....	7.78
Demand.....	7.80
Lire, cents: Cable.....	5.71
Demand.....	2.55
Marks, cents.....	

Eastern Metal Market

New York, June 9.

Demand for all the metals is still light and the effect of the railroad demoralization are still apparent.

The copper market is inactive but prices are fairly steady. Quietness pervades the tin market and prices have fallen sharply.

Buying of lead is not heavy but prices are firm.

The zinc market is a little stronger and prices fairly active.

Antimony demand is light and prices lower.

IRON AND STEEL

Producers and industrial consumers of steel are still so involved in delivery troubles that new buying and developments affecting prices are entirely secondary, says 'The Iron Age'. In some published statements the week's movement of iron and steel has been put too favorably. Chicago has made practically no gain; concerning Pittsburgh conditions, reports are conflicting. However, the strike is wearing out, and in some districts more rapid improvement is promised for the coming fortnight.

The fuel situation still hampers some pig-iron steel producers seriously. Foundries in all parts of the country are crippled for lack of coke, and in turn lack of castings is cutting down operations of machine-shops and automobile factories. The decrease in automobile production is due in part, however, to a slump in demand for all but the cheaper cars. Men laid off by automobile makers at Detroit have appeared in the Chicago district seeking work at steel-plants.

Inquiry for pig-iron for export, including both foundry and steel-making grades, is active and it would be possible to export considerable if the iron could be obtained, but furnaces at the present low production are slow to take foreign business.

COPPER

There is very little change in the general situation. Demand continues very light and production is curtailed because of labor and railroad difficulties. It is stated that in the case of copper, lead, and some of the metals the only way to make shipments is in train loads made up by various producers. There has been a slight easing in prices, that is, leading producers will sell electrolytic and Lake copper at 19c., New York, for June and July delivery instead of June only. For forward delivery a slight premium is asked. There is constantly a fair demand for export. Confidence is expressed that the future of copper is bright and that ultimately prices will be higher because of a large inevitable demand.

TIN

The feature of the week has been the decline of spot Straits to new low levels, 48.50c., New York, having been the bottom on June 7. The week has been a quiet one with only one active day; on Friday, June 4, about 325 tons of Straits tin was sold on the New York Metal Exchange, mostly future shipment, at prices ranging from 48.50c. to 48.75c. For metal spot on dock, 49c. was realized. On June 1, 2, and 3 sales were small at prices ranging from 49.62½c. to 50.62½c. for future shipment. There has been a good inquiry thus far this week. Yesterday spot Straits was higher than on Monday at 39.25c., New York, due to an advance in London of £4 per ton to £280 yesterday over Monday. The London quotation a week ago was £287 5s. per ton. Arrivals thus far this month have been 1185 tons, with the quantity afloat reported at 5045 tons.

LEAD

This market presents such a mixed aspect that quotations

for early delivery are anybody's guess. Very little business is being done, though the tone of the market remains firm. The steadiness is due to short supplies, the scarcity in general being pronounced, without doubt. Another cause of the firmness is the fact that there are few sellers. Because of this lack of offerings and of buying, quotations are largely nominal at 8.80c. to 9c., New York, for early or June delivery, with St. Louis quoted at 8.50c. to 8.65c. The leading interest's prices are unchanged at 8.25c., St. Louis, or 8.50c., New York. Spot lead is held firm at 9c. to 9.37½c., New York, with sales made yesterday at 9c. The fact that foreign lead or lead re-shipped from England can be sold in New York at a profit at 9c. is not taken seriously, as the margin of profit is too small.

ZINC

This market has undergone very little change, except possibly a slight improvement in tone. Demand is still hand to mouth. The London market has been stronger and so has sterling exchange the last day or two, which largely explains the firmness. Another factor is the slackening in production due to strikes, labor, and fuel troubles at smelting centres. Prime Western for delivery in the next three months is quoted at 7.75c., St. Louis, or 8.10c., New York. Large producers continue to meet the demand of their regular consumers but otherwise are not actively interested.

ANTIMONY

There is little demand and prices are lower at 8.75c., New York, duty paid, for the better grades and 8.62½c. for the poorer for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted at 33c. per pound, New York, for wholesale lots for early delivery by the leading producer, with other interests asking \$1.50c., New York.

ORES

Tungsten: The tariff matter is now postponed until next winter when Congress meets again and the market is left to its own course until that time at least. A resumption of buying is expected now. In the meantime prices are nominal at \$6.50 to \$7 per unit for Chinese ore, which is the chief source of supply at present.

Ferro-tungsten is quiet at 85c. to \$1.15 per pound of contained tungsten.

Molybdenum: The market is dead and prices are nominal at 75c. per pound of MoS₂ in regular concentrate.

Manganese: Little business is reported, although demand is strong and good offerings could easily be disposed of at 80c. to \$1 per unit for high-grade ore. Imports in April were 35,088 tons, bringing the total for the 10 months ended April 30, 1920, to 186,986 tons, as compared with 421,258 for the same 10 months in 1919.

Manganese-Iron Alloy: There has been no changes or developments. Prices are the same as a week ago at \$250 for June and \$200, delivered, for last half for domestic ferro-manganese. Sales have been light as well as demand. Imports in April were 3018 tons, which is only slightly above the monthly average for the first quarter of this year and for all of 1919. Spiegeleisen is quiet but strong at \$75, furnace.

During the last year production of copper has been at the rate of about 140,000,000 lb. of refined metal per month. Recently, however, even this curtailed production has not been sold. The president of one of the larger copper companies estimates surplus stocks of refined copper on hand at 650,000,000 pounds.

Mining and Scientific Press

EDITORIAL STAFF

T. A. RICKARD, EDITOR
L. A. PARSONS, ASSOCIATE EDITOR
A. B. PARSONS, ASSOCIATE EDITOR

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

ESTABLISHED 1860

Published at 420 Market St., San Francisco,
by the Dewey Publishing Company

BUSINESS STAFF

C. T. HUTCHINSON, MANAGER
E. H. LESLIE, 600 FISHER BLDG., CHICAGO
F. A. WEIGLE, 3514 WOOLWORTH BLDG., N. Y.

SCIENCE HAS NO ENEMY SAVE THE IGNORANT

Issued Every Saturday

SAN FRANCISCO, JUNE 26, 1920

\$4 per Year—15 Cents per Copy

TABLE OF CONTENTS

Page

EDITORIAL

NOTES 925

GEOLOGY FOR MINERS 927

Comment on the series of articles by S. J. Lewis. The value of the graphic method of description. Contacts with igneous rocks. Louis Reber's work at Jerome. The early suggestions of Emmons and Von Groddeck, laying stress on the importance of studying structural geology. J. E. Spurr's handbook. Interest in Mexican deposits.

IMMIGRATION 927

Legislation to restrict the inflow of aliens. Effects of the migrations of population on the countries of departure and arrival. Exclusion of undesirable. Our efforts to keep out the Oriental races. The opposing policies of the labor-unions and the capitalist corporations. What is best for the Nation?

DISCUSSION

AN INTERESTING EXPERIMENT

By Chas. W. Gardner..... 929

Behavior of mercury into which a gold bar is dipped.

THE PRICE OF GOLD

By A. Moline 930

Appreciation is justice not 'luck'. Misapprehension of Thomas French. Some basic propositions.

GEOLOGICAL EXPERTS IN THE COURTS

By Wm. E. Colby..... 930

Specially qualified judges for extralateral suits. A suggestion for the selection of experts. Simplification of laws v. requirements of actual mining.

THE BUNKER HILL TRAMWAY

By Wm. Hewitt 931

Further facts regarding the old aerial tramway.

THE CASE OIL-FIRED ASSAY-FURNACE

By J. Claire Evans..... 931

Some recent improvements in the furnace.

GOLD IN NORTH-EASTERN SIBERIA

By W. H. Shockley..... 931

Experience of an early-day prospector in Siberia.

ARTICLES

THE ORE DEPOSITS OF MEXICO—III

By S. J. Lewis..... 933

Deposits wherein the igneous rocks play a less prominent part. The El Oro-Tlalpujahua district. The system of faulting and the fault-block. The Sultepec-Zacualpan district. Intrusives of green andesite in shale. History of the mining operations. Zacualpan and Benito Juarez districts. The part played by dikes.

INITIAL VELOCITY OF BUBBLES IN A PNEUMATIC FLOTATION-CELL

By Melvin S. Donaldson..... 940

Two hypotheses. Apparatus used in experiments. Proof that bubbles have no initial velocity. Effect of increased pressure is to increase the number of bubbles.

THE ANALYSIS OF MAGNESITE

By W. C. Riddell..... 943

The method used at the Berkeley Experiment Station of the U. S. Bureau of Mines.

AN IMPROVED WEDGE FOR DEFLECTING DIAMOND-DRILLS

By C. Erb Wuensch..... 945

The faults of the ordinary wedge. Construction of new device.

FEDERATED AMERICAN ENGINEERING SOCIETIES 947

Constitution adopted at meeting in Washington, on June 3. An organization of societies, not of individuals.

NOTES

THE 'M-Z' AUTOMATIC MINE CAR

By O. J. Zook..... 932

DIAMOND MINING IN AFRICA..... 939

PETROLEUM IN CZECHOSLOVAKIA 942

GRAPHITE IN WESTERN AUSTRALIA..... 944

DEPARTMENTS

REVIEW OF MINING 949

THE MINING SUMMARY 957

PERSONAL 958

THE METAL MARKET 959

EASTERN METAL MARKET 960

INDUSTRIAL PROGRESS 961

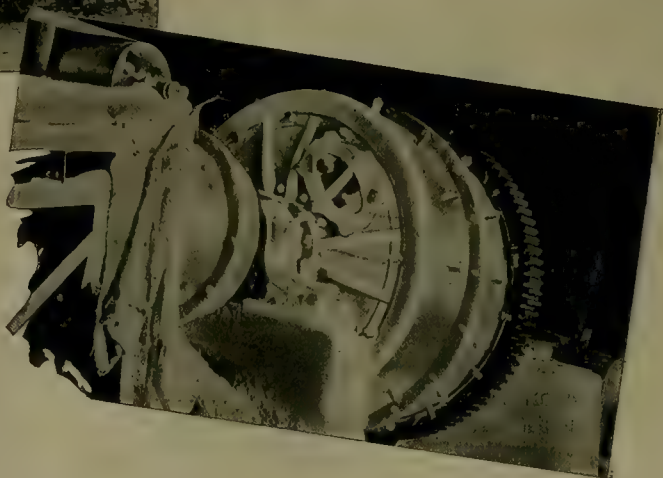
Established May 24, 1860, as The Scientific Press; name changed October 20 of the same year to Mining and Scientific Press.
Entered at the San Francisco post-office as second-class matter. Cable address: Pertusola.

Branch Offices—Chicago, 600 Fisher Bldg.; New York, 3514 Woolworth Bldg.; London, 724 Salisbury House, E.C.
Price, 15 cents per copy. Annual subscription, payable in advance: United States and Mexico, \$4; Canada, \$5; other countries, \$6.



*The Nevada Packard Mines Co.
Lower Rochester, Nevada*

**MARCY
BALL MILL**



ANOTHER SATISFIED USER

"We have just put in operation one of your No. 63 Marcy Ball Mills, and apparently it is going to do all that is claimed for it. This mill is being operated in connection with a tube mill using pebbles, and it now looks as if our only trouble will be in getting the tube-mill to take the product as fast as the Marcy will deliver it."

The Nevada Packard Mill is one of the many satisfactory Marcy installations. Write our nearest Service Station for our booklet and complete information.

The Mine & Smelter Supply Company

A Service Station Within Reach of You

DENVER

SALT LAKE CITY

EL PASO

New York Office: 42 Broadway



T. A. RICKARD, Editor

AS many of our readers are aware, the editor of this paper has written a small book on 'Technical Writing' recently published by John Wiley & Sons, New York. He takes advantage of the opportunity to invite criticisms and will be grateful to those who will take the trouble to draw his attention to errors of any kind that they may detect in the course of their reading of the book.

HOARDING of silver and gold in the countries of the Orient causes a large proportion of the world's annual output of the precious metals to be withdrawn from use in commerce. It is stated, for example, that the Military Governor of the Province of Shahnsi, in China, has issued a proclamation with a view to persuading the wealthy people of Taiyuanfu and other cities in Shahnsi not to hoard silver in their gardens and fields, but to show confidence in their officials by using the metal for trading purposes. It is estimated that the natives of this Chinese province have hidden silver 'shoes' by the thousand, as well as silver dollars, in their cellars underground. In view of the absence of strong banks and the lack of confidence in the Government, it is doubtful whether the Governor's proclamation will cause the natives to 'dig up' their silver.

ORE-BUYERS and mine-operators in the Miami district of Oklahoma are both quite certain that they are not liable for the payment of county taxes on several thousand tons of lead and zinc concentrates that had accumulated in the bins of the mining companies on January 1, as a result of the shortage of railroad cars. Mr. E. E. Shipley, the local tax-collector, is not particular as to who pays the taxes, but he is persistently and consistently insistent that somebody must pay them. The mining men aver that they had sold the concentrates and should not be taxed for material they did not own, just because it happened to be stored on their premises. The ore-purchasers as firmly maintain that until delivery had been effected the concentrates were not their property and should not be assessed to them. We hope the miners will make good their contention.

MEXICO'S trade with the United States is increasing steadily. In 1910, says the National City Bank of New York, it was \$115,000,000; the revolutions of Madero and Huerta reduced it to \$110,000,000 in 1915; since then, despite the Villa and Carranza revolutions, it has

risen steadily from \$191,000,000 in 1917, to \$245,000,000 in 1918, and \$278,000,000 in 1919. According to the latest figures, this international trade will be at least \$300,000,000 for the fiscal year ending on June 30. Of the total commerce last year, \$148,926,000 represented our imports from Mexico and \$131,452,000 our exports to that country. Among our imports the chief products are sisal (a vegetal fibre, like hemp), petroleum, copper, cotton, coffee, hides, and lead.

RECENT episodes in California have shown that the disciplining of wild-cat mining schemes by the Commissioner of Corporations is hardly sufficient, under the existing law, to prevent fraud. Clever promoters of an irresponsible character are able to circumvent the statute. We note that the West Australian parliament has passed an act recently for the purpose "of protecting the public from the operations of wild-cat schemes. The regulation assures that all money subscribed for developing mines shall be used." We hope it will. The cynic will laugh at this belated spasm of virtue at Perth, for it comes at a date when the gold-mining industry of Western Australia has passed, in large measure, out of the exuberant stage and is marked by the sobriety of proximate exhaustion. Time was when the 'wild-cats' of Kalgoorlie and Coolgardie were so ferocious, it is said, that they accounted for the lack of rabbits in Western Australia.

"MR. NELSON BIGELOW, of Silver Centre, was admitted to the Providence Hospital at Haileybury yesterday suffering from an accident to his face and hands, caused by the exploding of some dynamite. According to Mr. Bigelow's own story, he was working at a mine, and blasting at intervals. One blast failed to go off and he endeavored to explode the charge by hitting the cap with a hammer. The force of the explosion hurled him some 30 ft., badly cutting his hands and left portion of his face. Assistance was rendered him by some of the men, and he was rushed to the hospital here. His injuries are not considered to be dangerously serious, and a speedy recovery is looked for." This dispatch is from an entirely reliable source in Ontario. We have heard of the man who insisted on crimping caps with his teeth, and did it once too often, and we have distinct recollections of the man who drilled into the socket of a missed hole to save a few inches of drilling; but we believe that the performance of this gentleman is unique.

Fate has been unkind to the undertakers of Silver Centre. Such folly as caused the accident might have led to the loss of many more valuable lives. Has all the 'Safety First' propaganda been used by Mr. Bigelow for lighting his pipe?

CHANGES in the provisions of the Yukon Placer Mining Act are being considered by the Canadian parliament. In the hope of stimulating placer mining it is proposed to lease the land lying along the favorably situated creeks for a rental of \$25 per mile. The original lease of one year may be renewed twice for a similar period provided \$1000 is expended in prospecting and development. In respect of ground that has been once worked and abandoned, the maximum distance allowed in a single lease is to be five miles, and within it as many claims of standard size as desired subsequently may be staked. The lease in virgin territory must not exceed one mile along the creek, and only one claim can be staked; it may, however, have the dimensions of a discovery claim, which is three times the regulation size. Large areas of gold-bearing gravel that cannot be profitably worked by the methods of the individual miner are sufficiently rich to be exploited on a big scale by means of more elaborate machinery and equipment. To warrant the investment of the necessary capital there must be assurance of a more extended scope of operation and to this end the proposed modifications in the law were suggested by the Yukon Development League. If the Act be passed, as seems likely, the region made famous by the Klondike may again contribute to the world's dwindling production of gold.

PSEUDOMORPHS of geology are common on the oil fields; the science of Lyell and Le Conte is given a Koster & Bial treatment that is the essence of caricature. We have been favored with the copy of a report on an oil venture in Robertson county, Texas. In that report we are told that "the first horizon stone is principally of sand; however, some lime contamination was in evidence. Iron silicate of considerable salacious properties was in evidence." Some kinds of burlesque are salacious. "The erosions that have come from these domes show a small trace of carbon and also slight sulphur contamination." They ought to; in truth, the language needs to be fumigated. The writer is modest withal; he says: "I do not insure the finding of oil and gas, but when one puts their best efforts forward in a diligent search and finds such great nucleus of evidence, it is reasonable to expect that those who may drill upon the advice of a geologist are likely to be rewarded by the finding of the commercial fluids." Blessed are they that expect much, for they shall be comforted with the thought that they might have lost their money in some other way. "The epochs that lay at their respective levels according to all geological research, show this zone to be properly laid down and all affinities are in keeping with things that we look for, hence where so much evidence has concentrated in one locality and nothing being found radically contrary, it is quite likely that our diag-

nosis will prove correct." But like other diagnoses by the ignorant, it is more likely to prove fallacious. We wonder how he pronounces "research". The reference to "affinities" is dangerous; should one call this a *geologic crime passionnel*?

HENCEFORTH the Canadian Mining Institute will be known as the Canadian Institute of Mining and Metallurgy. The change follows in the wake of the example set by the American Institute of Mining Engineers, which is now the American Institute of Mining and Metallurgical Engineers. These North American professional organizations have copied the style of the Mining and Metallurgical Society of America and the older British society, the Institution of Mining and Metallurgy. We regret the attempt to be specific, whereby the names of these societies become exclusive of many engineers engaged in the mining industry and therefore properly members of such organizations. The geologist and the chemist, for example, are apparently excluded by the effort to include the metallurgist and his art in the title. However, it seems to be the fashion to add to the length of these names without adding to their descriptive value, so the less said the better; but it is worth while to record the changes as they are put into effect. Whatever its name, we wish continued success to the Canadian Institute. We regret to note that Mr. H. Mortimer-Lamb has found it necessary to retire, with the honor of appointment as Secretary Emeritus. Upon its secretary a technical society depends largely for its success. We hope the Canadian Institute will find a good one to replace Mr. Mortimer-Lamb, but it will be difficult to do so.

STATISTICS of immigration and emigration in 1919 show that the net gain to our population last year was only 4636, as compared with a net gain of 1,017,957 in 1913, which was the record year in this respect. The alien outflow in 1919 was the largest for five years; the departures were mostly to Italy, a fact that has led many to place the responsibility on prohibition. We doubt whether the 18th Amendment was the cause, except in minor degree. However, it is noteworthy that there was a heavy emigration from this country to the shores of the Mediterranean, whereas, on the other hand, there was a notable increase of immigration from the British isles and from France; so that there seemed to be a satisfactory reversal of the flow that was bringing us an excessive proportion of the poorer (in character and intelligence, which are more important than wealth) peoples of south-eastern Europe. The departures numbered 392,526, as against 397,162 arrivals; and it is remarkable that the number of aliens entering the United States from the Canadian and Mexican borders was the largest since 1914. At the present time the influx at the port of New York is about 10,000 per week, so that the current year ought to show a considerable change in the statistical record. As yet the entry of aliens into the United States is still subject to restrictions established during the War; none can enter except under passport

issued by our representative at the port of embarkation after the applicant has undergone examination, and the steamship companies are subject to punishment under the law if they admit any alien excluded by existing regulations. The legal conclusion of the War, by ratification of peace, should facilitate immigration considerably, but we hope that the proper restrictions and regulations will not be waived even then, for reasons that we discuss in another column.

Geology for Miners

In this issue we print the third of a series of articles on the ore deposits of Mexico by Mr. S. J. Lewis. The two previous ones appeared in our issues of March 20 and March 27, the continuity of publication having been broken by interruption in the postal service. In his latest contribution to the study of the subject, Mr. Lewis describes and analyzes the distribution of ores in sedimentary rocks, more particularly those not at the contact with igneous intrusions. He instances El Oro, where rich veins of gold-silver ore have been followed through shale into andesite and again into shale. Although the ore does not follow the contacts between the shale and the intruding andesite, yet it is evident that the formation of the vein-fractures and their enrichment by the precipitation of valuable minerals has come in the wake of the structural conditions created by the bending and breaking of the shale near a mass of hot rock within the horizon of solutions containing the precious metals. Between Sultepec and Zacualpan somewhat similar conditions obtain. At Ajuchitlan the distribution of the ore is more immediately associated with a contact, where a tongue of porphyrite has broken into, and shattered, the shale. This reminds us of the excellent work done by Mr. Louis E. Reber at Jerome, Arizona, and of his remark: "Important ore deposits are usually related to apophyses or outlying porphyritic phases of batholithic intrusions rather than along the walls of the main masses." We shall not review Mr. Lewis's article in further detail, as we desire at this time merely to point out that he is giving the miner the information most needed in his search for ore underground. The analysis of the structural conditions favorable to the deposition of ore, together with sketches that explain the analysis graphically, is, in our opinion, the best way of helping the miner, more particularly the superintendents of mines and the consulting engineers who co-operate with them. It is 32 years since S. F. Emmons gave the Institute his paper on "Structural Relations of Ore Deposits"; time and experience have tended to confirm the correctness of the quotation from Von Groddeck that served as the text for his illuminating suggestions. The German geologist said: "The obscurity which still veils from us the true nature of veins will become more and more cleared up when they can be considered in connection with the geological structure of the regions in which they occur." To this may be added the suggestion that the finding of ore will be increasingly facilitated by the study of the structural conditions more immediately

associated with the precipitation and distribution of the ore in the veins or other forms of deposit. The study of the ultimate origin of ores is interesting, of course, and for a time, marked by the publication of the treatises by Posepny and Van Hise, this question of genesis absorbed a large share of attention among mining geologists and engineers. We recognize that the ensuing discussion was valuable in establishing sundry fundamental facts, more particularly the character and circulation of the ground-water, but it must be confessed that in the enthusiasm of scientific inquiry the real purpose of mining, which is to find and exploit ore profitably, was not kept in view. We do not say that speculations concerning the origin of ore are valueless to the miner; on the contrary, they serve to sharpen his understanding and to quicken his observation, but, when all is said and done, it is much more important to the miner to be told where the ore is now than where it used to be; to be guided in his search for the geologically recent concentrations that he finds it profitable to dig rather than to be told the fascinating history of the chemical changes and devious migrations by which the ore was brought from unknown depths or unseen sources to the place where his pick strikes into it with a joyous whack. No mention of this subject of applying geology to the finding of ore can be made without reference to the deservedly popular handbook of Mr. J. E. Spurr, "Geology Applied to Mining". This *vade mecum* of the mining engineer was published in 1904, sixteen years after the famous paper by Emmons to which we have referred, and in large measure it may be considered its logical successor. Since he wrote his book, Mr. Spurr has demonstrated his own peculiar skill in deciphering the underground structure of several famous mining districts and has carried forward the Emmons tradition of making the science of geology the guide, philosopher, and friend of the mining industry. Just now the hope of a restoration of law and order in Mexico is awakening a revival of interest in Mexican mining affairs, therefore the articles by Mr. Lewis are timely. We shall be glad to receive notes or discussion on the subject from others familiar with conditions in the mining districts of Mexico.

Immigration

A bill is before Congress to bar immigration for two years, but it is not likely that any new legislation on the subject will be enacted just now. War regulations are still restricting the entrance of foreigners. The leaders of labor are urging a ban on immigration, while the leaders of capital are proclaiming that there will be a shortage of labor in the near future unless the gates are kept open. Most of us will be unsympathetic to such obviously selfish arguments; the problem is one of national importance and demands unbiased consideration. It is also a world problem. The admission of multitudes of foreigners may relieve the pressure of population in the countries of origin, but it is held by sundry economists that such emigration does not benefit those countries, largely because it stimulates an excessive birth-rate. The argu-

ments for restriction are various. Time was when we needed help from across the Atlantic in order to develop our surplussage of natural resources; our population was too small for our patrimony; now most of the immigrants go to the manufacturing centres, rather than to the land, either agricultural or mineral. Most of them crowd into our cities, it is said. Meanwhile some of our people view with alarm the prospect of a density of population like that of the congested regions of Europe, because it would involve a lowering in the standard of living and a degradation of the national type, for, just now particularly, there is a widespread desire to hasten the Americanization of the unassimilated foreigner, rather than to add further to the mass of undigested elements in our population. The question follows, how much should immigration be restricted? We have the Chinese Exclusion Act and the 'gentleman's agreement' with Japan. In 1917 the test of literacy was adopted by Congress, but it fails to exclude the most objectionable, namely, the half-educated unruly rejects of Europe, the men and women who too readily join the ranks of those that are opposed to any form of orderly government. An effort is made to exclude those manifestly diseased and those belonging to the criminal class, but complete discrimination is impracticable. Nor can we see how any tests can be devised that will be wholly effective. The advocates of restriction hold diverse opinions; some wish to exclude Asiatics; others, the Balkan peoples; some might carry their prejudice to the point of excluding Germans, or, dare we suggest, the Irish? Mr. Hearst, if he were logical, would bar the English from coming to a land their forefathers founded. Most ideas of exclusion when made specific are easily reduced to an absurdity. The most logical argument is that of the leaders of organized labor; they aim to exclude others like themselves in order to create a shortage of workmen and thereby increase the demand for their services. That is the expression of a perfectly intelligible policy based upon class-selfishness, but it has nothing in it that is patriotic in sentiment or national in spirit. It is true likewise that the capitalists desire to flood the labor market with the European horde, for reasons equally selfish. The professional class will detach itself from either party to the quarrel, preferring to face the problem with a larger mind and a more generous spirit.

What is best for the Nation? Shall the leading democracy of the world adopt a reactionary policy? What about the time-honored sentiment of an open door to the oppressed of every land? That generous policy had its political aspect, for it served to strengthen the young republic in the days when it needed greater security from foreign aggression. It had also an economic basis, for land was plentiful and an increase of population benefited all who were in the country. Another argument is that the incoming tide of humanity pushes itself underneath American labor and lifts it to a higher level, so that while the immigrant is bettered, our citizens are thrust into a more advantageous position. That reminds us of Francis A. Walker's statement that the great immigration during the thirty years preceding the Civil War

had the effect of causing a marked decline in the birth-rate of the native stock, so that at the end of the thirty years the population "differed by less than 10,000 from the population which would have existed according to the previous rate of increase, without reinforcement from abroad". General Walker was superintendent of the ninth and tenth censuses. He attributed the fact just mentioned to the introduction of large numbers of European peasants, creating distinct social classes and producing a complete change in economic conditions. The native stock went above or under, mostly above, acquiring a larger measure of wealth and leisure. With the improvement in social status came a restriction of the birth-rate such as is characteristic of the propertied class everywhere. Undoubtedly the foreign-born are more prolific than the descendants of the New Englanders and the Virginians. Those who gave us a rich heritage of democratic institutions are being displaced by the Slavic, Balkan, and Mediterranean peoples. But can we discriminate specifically against this or that race? It has proved difficult and dangerous, if not impracticable, as against the Japanese; could we discriminate, by legislation, against any of the European countries, more particularly the young republics created by the reorganization that has resulted from the War? If we could, would we? Would it not be better to face frankly the task of making the best of the incoming alien, by educating him to the point of American citizenship, meanwhile deporting those who are blatantly opposed to our institutions? Shall we not lose by stopping all immigration? After all, the American people consists of immigrants and their descendants. In President Wilson's cabinet were two immigrants, and the resignation of one of them does not depreciate his value as a citizen. Among the sanest leaders of labor there are two immigrants, Messrs. Gompers and Morrison. In every walk of life we find men that were born outside the United States and came here to find a career, useful not only to themselves but to the country of their adoption. Congress includes a large number of foreign-born, although the cynic again may smile and suggest that the argument is a weak one. Be that as it may, it remains true, as President Wilson said in his message of January 23, 1915. "Exclusion, adopted earlier in our history as a nation, would very materially have altered the course and cooled the humane ardors of our politics. The right of political asylum has brought us to this country many a man of noble character and elevated purpose who was marked as an outlaw in his own less fortunate land, and who has yet become an ornament to our public counsels." This is not particularly well expressed, but it is the utterance of a representative man, a student of our history and an earnest thinker. Are we threatened with a big influx of foreigners? We doubt it. Prohibition will serve to deter many from coming; the creation of new countries and the enlargement of opportunity in the young republics of Europe will hold many that might otherwise have come here. Let us face our social problems with courage, confident in our ability to solve them, rather than shirk the responsibilities that our destiny has imposed upon us.

DISCUSSION



An Interesting Experiment

The Editor:

Sir—The somewhat remarkable and unexpected results obtained in making an experiment with gold and quicksilver may be of interest to your readers. During a conference with E. W. Herrin, who is in charge of the gold department of Yuba Consolidated Gold Fields at Hammonton, California, certain questions arose as to the action of quicksilver upon gold, and it was decided to make an experiment.

In a small vial, $1\frac{3}{8}$ inches high and having an inside diameter of $\frac{3}{4}$ in., Mr. Herrin placed an ounce of clean quicksilver, which filled the vial to a depth of one inch. A bar of nearly pure rolled gold, $2\frac{1}{2}$ in. long, $\frac{1}{4}$ in. wide, and two thousandths of an inch thick, was placed in the vial and immersed in the quicksilver to a depth of $\frac{3}{4}$ in. The upper end of the bar was then bent over the mouth of the vial and left extending outward and slightly downward, with the end on a level with the surface of the quicksilver in the vial. In 43 hours the bar of gold was completely coated with quicksilver. In 168 hours quicksilver started to drop from its outer end, and a small dish was placed to receive it. In 720 hours half an ounce of quicksilver had been drawn from the vial, passed over the gold bar, and collected in the small dish.

The bar of gold before being placed in the vial weighed 6.2 grains. At the end of the 30 days it weighed 4.3 gr., 1.9 gr. having been dissolved in the quicksilver. Of this amount 1.68 gr. was found contained in the quicksilver remaining in the vial and 0.22 gr. was found in the half-ounce of quicksilver in the small dish.

It is possible that some of your readers may be able to explain the action that caused the quicksilver to be drawn from the vial and conducted over the gold bar. It is also interesting to note that in a similar experiment made under water the gold bar became amalgamated, but no quicksilver dropped from its outer end.

San Francisco, June 7.

CHAS. W. GARDNER.

The Price of Gold

The Editor:

Sir—In your issue of March 6 last, the gold-producers of South Africa are congratulated upon having had a turn in their luck, and there is also a letter from Mr. Thomas French pointing out that Great Britain had been selling an ounce of gold for six sovereigns.

The gold question, as you say of exchange, has many facets, and though I am not capable of dealing with

many of them, I would like to call attention to one or two points that affect the gold miner.

There is a tendency to regard the premium on gold as unearned increment which gold miners are obtaining by some astute device at the expense of the rest of the world. Congratulating the producers of South Africa upon a turn in their luck, puts the matter in a very different light to that in which we see it. Owing to the exigencies of war, the British government, and practically every other government, found it necessary to control all traffic in gold. This control prevented gold from exercising its proper function in finance and undoubtedly contributed to the general rise in the price of commodities. Further, this control included the making of the paper currencies of various countries inconvertible, the direct effect of which is to displace gold from its position as a standard of value and make it just an ordinary commodity. During the course of the War every other commodity increased very largely in price, but the price of gold was fixed. The gold-producers raised no very loud protest, although production declined throughout the world to the extent of about 25%. After the Armistice, the Australian and South African gold-producers were able to make sufficiently strong representations to enable them to obtain access to an open market and thereby receive the real value of their produce, but this is hardly "luck"; it is only justice, deferred for some time owing to compelling circumstances.

Referring to Mr. French's letter, he draws some interesting conclusions, but his whole letter is based upon a misconception. He states that "gold is sold or exchanged in England in the best market and for this gold the producers now demand between £6 and £6.25 per ounce, *either in gold sovereigns* or their equivalent in other goods". The italics are mine. An ounce of gold fine can be exchanged for 4.25 sovereigns, and 4.25 sovereigns can be exchanged for an ounce of fine gold, for all practical purposes they are identical, the only difference being the cost of minting. When gold was quoted in London at £6 per ounce, it meant that for an ounce of gold you could get six British notes or a negotiable instrument of equal face-value, or the equivalent value in other goods, but six sovereigns could not be got for an ounce of gold under any conceivable conditions. Suppose, for the sake of argument, one could get six sovereigns for an ounce of gold; they would be immediately melted down, making an ounce and a half of gold, for which one would proceed to obtain nine sovereigns and this in turn melted into $2\frac{1}{4}$ ounces would be sold for 13 sovereigns, and so on *ad lib*. It is exactly comparable to

the principal or perpetual motion, which, for some time past, has been held in discredit.

The question has a number of other aspects, but in order to follow any of them with advantage one or two basic facts, which are not difficult to grasp, must be recognized and the basis of the matter appears to be that

1. Gold is the accepted standard of value.

2. Gold is also a commodity and its price may vary if anything is done to interfere with its use as the standard of value.

3. War control of finance has so interfered and thereby caused the fluctuation in the price.

4. The price is expressed in the unit of measurement in current use and just now that is paper currency, not metallic currency.

5. Bar-gold of specified fineness and sovereigns or other gold coin are interchangeable on a fixed arithmetic basis only.

What is of interest to gold miners is the place that gold is likely to occupy in finance and in the arts for the next few years. There are so many conflicting factors that it is a somewhat hopeless task to attempt to find the algebraic result, but, looking at the matter broadly, it seems likely that the old basis, which took five years to destroy, is unlikely to be completely re-established in a shorter period, and as re-construction is a more difficult and longer job than destruction, gold-producers can reasonably expect that a substantial premium may be got for even a longer period. On the other hand, the gold miners, like everyone else, would quite gladly see the price reduced provided that there was a general return to something approaching the normal trade conditions of the good times before the War.

Bendigo, Victoria, May 5.

A. MOLINE.

Geological Experts in the Courts

The Editor:

Sir—Referring to your recent discussion of the above subject, I venture to quote from my paper, published in 1917, on 'The Extralateral Right', in which I suggested a remedy for a state of things that has recently given rise to much well founded criticism.

"As a matter of fact the objection that experts employed in mining litigation become advocates can be met in another way and valid criticism based on the expense of extralateral trials overcome to a large extent by reform in the present objectionable methods of handling such cases.¹ It is admitted that the reform would have to be radical but it is worth considering, for the extralateral right is bound to be the subject of adjudication in the future, as in the past, at least, as far as existing vested rights are concerned.

"In each State there should be a provision added to its laws whereby a judge, specially qualified to try extralateral cases, could be called in to sit where such rights

are involved. To the average judge an extralateral suit is like so much Greek and a large portion of the trial is taken up with educating the court on the elementary principles involved. Most of the mining laws of other countries recognize the fact that mining cases involve technical problems that cannot be satisfactorily and intelligently adjudicated by the regular courts and, consequently, in practically all foreign countries a special tribunal is established to try mining cases.² In some countries jurors, even, are required to be experienced in mining.

"Another objectionable feature which can be readily improved, is the present method of employment by each side of an army of experts.³ Practically all extralateral cases resolve themselves, sooner or later, into a battle between opposing experts. This results in great expense as well as confusing exaggeration of structural details of minor importance. In a great majority of cases justice could be as readily obtained by a board of experts, one to be selected by each side and a third by the judge of the court, the expense to be shared equally by each party. These experts could examine the properties involved and make a report on the geological occurrences. They would agree on most facts, and where there was a difference of opinion litigation work could be ordered to further develop the points of difference. This plan would eliminate much of the expense and time consumed in such trials. The court would accept the facts agreed on as proven and confine the trial to disputed issues. This plan or some other framed along similar lines would do much to remove the stigma of an excess of expensive litigation to which the extralateral right is now properly subject. It would tend to minimize the existing evil which will still continue to abide with us in the case of all existing claims and would obviate a plunge into untried dangers and hazards which are bound to follow a radical change in our present law.

"If it is litigation we wish to avoid, then why not also take up the question of compelling all locations in the future to conform to legal subdivisions.⁴ By requiring lode-claims to be located in conformity to public-land surveys as is now required in the case of placers and also by registering all locations in the land offices, it will readily be seen that a vast amount of litigation arising by reason of conflicting surface-rights would be elim-

²Any one who was familiar with the trial of mining cases in the federal courts before judges like Hawley or Hallett, who thoroughly understood these technical mining problems, will appreciate the great saving of time and expense which would result from the trial of technical cases by a specially qualified judge.

³The employment of experts in extralateral litigation is not an unmitigated evil. In many cases orebodies of considerable value have been encountered as a direct result of litigation work or suggestions of the experts and in many mines the geological conditions are slighted and but poorly understood until an extralateral suit is instituted and then the first scientific information of value is obtained concerning a mining camp.

⁴This is not a novel suggestion. See Trans. A. I. M. E., Vol. XLVIII, p. 422.

¹As Charles Shamel says: "The fault lies not with the apex law, but with the existing instruments and methods of legal procedure." Trans. A. I. M. E., Vol. XLVIII, p. 34.

inated. An amendment of the mining law as suggested would eliminate tenfold as many cases as would be eliminated by abolishing the extralateral right. But by each of these remedies the advantage of economic operation of the ore deposit as a geological unit would be sacrificed. The vein on its dip into the earth has nothing in common with the surface and to parcel it out by surface area and vertical boundaries is a structural misfit and so would be the forcing of lode-locations into rectangular surface-areas conforming to the public-land surveys. Such reforms are ideal from the standpoint of minimized litigation but intensely impractical from the standpoint of the most economic mining of the ore deposits."

San Francisco, June 4.

WM. E. COLBY.

The Bunker Hill Tramway

The Editor:

Sir—In your issue of May 15 is an article, No. 9, by Mr. T. A. Rickard, entitled 'The Bunker Hill Enterprise', in which he refers to the aerial tramway the equipment for which was furnished by the Trenton Iron Co. for the Bunker Hill & Sullivan Mining & Concentrating Co. in 1891. The statement is made that owing to defective design it proved a very expensive and troublesome affair, due to dropping of the buckets from the line, which resulted in the killing of persons in their homes and horses in the street.

The carriers of this line were equipped with grips of German design, and were attached to the traction-rope by means of lugs fastened to this rope at definite intervals, which engaged with the grip-forks, between the prongs of which there was a slight play, and I believe some trouble was experienced at the outset by the slipping of the lugs, which was finally overcome by what is referred to in the article as a "new type of button".

The original design, I know, contemplated a brake-station in the valley where the town of Wardner is located, and this I believe was in conformity with the wishes of the officials of the Bunker Hill company who had charge of this installation, and I have no doubt that trouble may have been experienced owing to the uplift of the traction-rope. I was informed of one woman being killed while asleep by a bucket discharging its contents through the roof of her home, an accident such as might happen to any new machinery of this kind. If other persons and horses were killed by the dropping of buckets, the present writer, who was instrumental in the design of this tramway, was not before aware of the fact.

The line was operated many years before it was finally superseded by the adit referred to in the article, and to the best of my recollection it was amply capable of transporting the amount of ore—50 tons hourly—for which it was designed. Far from being the conspicuous failure that the paragraph in the article referred to would lead one to believe it was, the Trenton Iron Co. did not hesitate to refer prospective customers to this installation, and to exploit it extensively in their advertisements, a view of that portion of the line showing the long span—

1173 ft.—across the town of Wardner being shown at a frontispiece in their book on aerial tramways. The reputation obtained through this line, I have reason to believe, resulted in other contracts being secured for similar lines.

I have been unable to locate the original profile, but since the span across the town of Wardner was 1173 ft., I cannot understand the reference to a span of 1400 ft. in the original design. The length of the line, according to the records at this office, was 9000 ft., not 10,000 ft., and assuming that Mr. Rickard is correctly informed as to the total cost, this must have been about \$10 per foot, which appears to be excessive for that time, and I am inclined to believe is mainly due to the changes rendered necessary by the condition stipulated at the outset of having a control station at the town of Wardner.

Pittsburgh, May 23.

WM. HEWITT.

The Case Oil-Fired Assay-Furnace

The Editor:

Sir—Mr. Borzynski's article on this subject in your issue of May 15 is full of interest.

To secure the best results in cupelling, experience has shown that the air to the burner should be cut down very low. At first thought this seems contrary to theory as in cupelling one naturally desires maximum oxidizing conditions. Perhaps by cutting the air down (and regulating the temperature by the oil-valve alone) there is less back pressure in the combustion chamber and less reducing gas forced into the muffle, but whatever may be the theory, by using this method, it is possible to feather seven or eight rows of cupels beautifully.

This type of furnace has been much improved recently; by using the new DFC burner, the regulation of both oil and air is made convenient and positive. In the new type, the enclosed hood probably assists the draft through the muffle.

Denver, June 7.

J. CLAIRE EVANS.

Gold in North-Eastern Siberia

The Editor:

Sir—Your editorial note, in the issue of June 5, stating that "north-eastern Siberia is not a country rich in gold" agrees with the information that I gathered while exploring that coast in 1900. Rumors of rich deposits in that region were current in London and I was given a steamer and a gang of workmen and sent to investigate the coast opposite Cape Nome. After learning from a whaling captain that a party of Americans had been digging ditches, presumably for gold-mining, at St. Lawrence bay, we were quite hopeful, but on arrival we found the work had been done by men who had come over from Alaska to buy reindeer. Prospecting parties of workmen under my charge found not even a color of gold. The chief of the Russian expedition that was also studying the region in 1900 told me that he had found two colors of gold, but he was unable to show them to me, as

they had been lost. Some of the American engineers who were with this Russian expedition could give interesting information about these gold discoveries and other incidents of that voyage.

Since 1900 Russian prospectors have examined the country and a sketch-map in a Russian pamphlet published in 1916 shows 30 localities in which gold had been found. The pamphlet states that while prospectors are sent to prison as 'poachers', development is handicapped. No evidence is given of any gold discoveries warranting a stampede. What the attitude of Lenine and Trotzky is regarding this region is unknown, but it seems most

used, although one make had a fair sale before the War. It is said, however, that a large proportion of the pumping on the Rand is done by American machinery.

The 'M-Z' Automatic Mine Car

By O. J. ZOOK

Mine cars of approximately one-ton capacity are used almost invariably in metal mines in the West. They must be designed to be readily dumped, and the increased use of electric motors for underground haulage



THE 'M-Z' MINE-CAR AS MADE BY THE BUTTE & SUPERIOR CO. FOR ITS OWN USE

likely that American prospectors would meet an unpleasant reception.

Palo Alto, California, May 9. W. H. SHOCKLEY.

THE production of rolled zinc in the United States in 1919 declined over 20% in quantity and 45% in value as compared with that in 1918. The percentage of loss in quantity was greatest in boiler-plates and heavy sheets, amounting to more than 60%, but there was a loss of nearly 30% in ordinary zinc sheets. The output of zinc strips, on the contrary, was slightly greater than in 1918. The losses were apparently due to the cessation of the demand for zinc for war uses. The principal producers and rollers of zinc, working through the American Zinc Institute, are endeavoring to find and establish new uses for rolled zinc and to extend the present uses. The substitution of sheet zinc for sheet copper and brass and for tin-plate, wherever possible, is urged, and likewise the substitution of sheet zinc for galvanized iron or other sheet metal in roofing, guttering, spouting, garages, refrigerator linings, household utensils, and hospital ware. The use of sheet zinc for roofing seems to offer the most promising field for expansion.

PUMPS of Swiss, British, and American manufacture are used throughout the Johannesburg district of South Africa. The Sulzer is said to be the most popular of the pumps manufactured in Switzerland. Those imported from England include the Climax, Tangye, Allen, Pulsometer, Pearn, Robeson-Davidson, and Rees-Roturbo. German pumping machinery has never been extensively

makes it necessary that special attention be given to the construction of coupling and bumping devices. Another important point is that the car can be manipulated with the least possible danger to the miner. During the past 20 years very little improvement has been made in the design of mine cars except for the adoption of roller bearings for the wheels. The accompanying illustration shows a car which has been developed by O. J. Zook and Charles Marshall at the Butte & Superior mine at Butte. The following features of the 'M-Z' car, as it is called, will appeal to those who are familiar with the difficulties met in the use of the ordinary car.

1. Nothing projects from either end of this car to be broken or bent when cars are bumped together in motor haulage.

2. The door is unlocked and locked automatically.

3. The body of the car is released from the truck, for dumping, by a foot-lever. The foot-lever does not project beyond the end of the truck frame.

4. The shackles for coupling the cars can be removed by taking out two cotter keys, which simplifies their removal when repairs are needed.

5. The repairs will be cut to a minimum by eliminating the hook-rod, and levers that are used on the ordinary style of car, and which cause 75% of the repairs.

6. The door will not 'hang up' due to the hook-rod being bent by bumping together. Accordingly the car cannot go over the dump or into the chute when being dumped.

7. Less than one-half of the time is required to dump the 'M-Z' car than is required with the ordinary type.

The Ore Deposits of Mexico—III

Non-Contact Deposits in Sedimentary Rocks

By S. J. LEWIS

INTRODUCTION. We now pass to an economically important class of ore deposits, chiefly in lime-shale, in which the part played by the associated igneous rock is of considerably less importance than in the preceding. In the typical mines, the shale is underlain by an intrusive, generally a rather basic andesite, and is heavily folded and broken, with important faulting of the orebodies after formation. Not necessary to the type, but

of the El Oro district are the best examples of this class. While their geologic features are well known to mining men interested in the district, they have not been fully described for publication, and it will therefore be allowable to summarize the most important features before going on to less-known examples.

The Cretaceous lime-shale, deposited over a large part of the Central Plateau, from Chihuahua through Du-

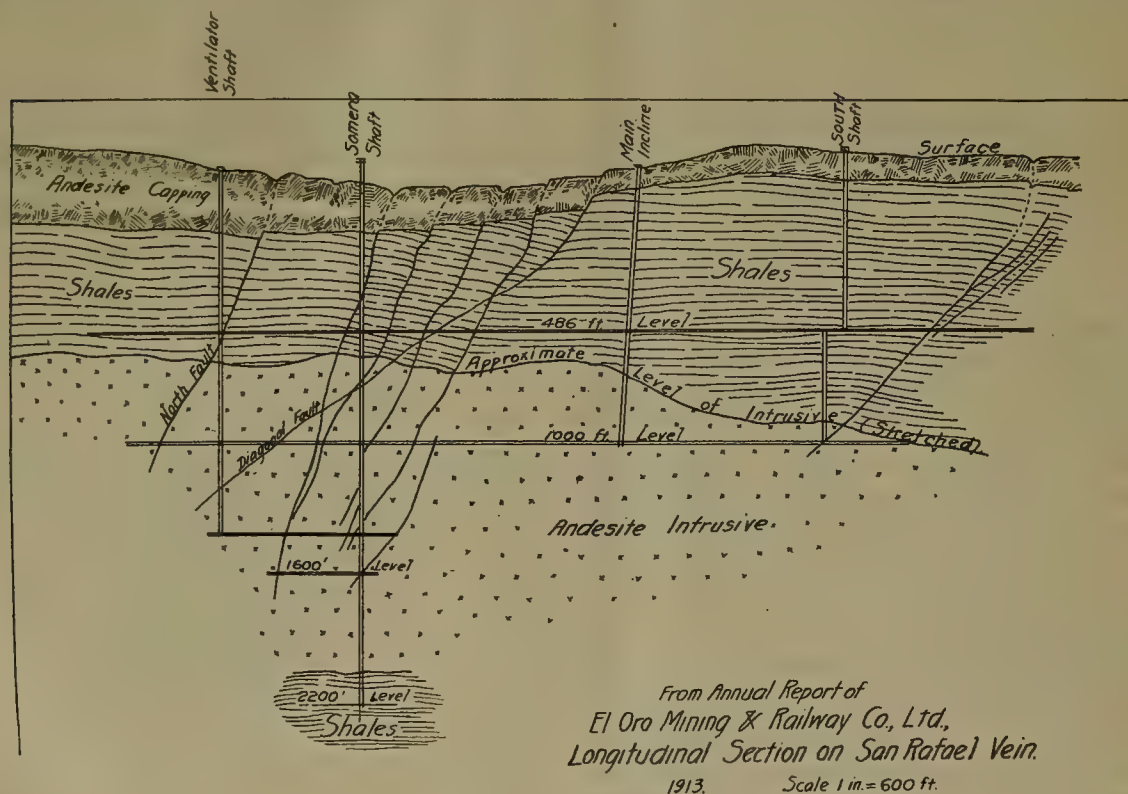


FIG. 10

frequently occurring, is a cap of andesite or rhyolite over the shale, earlier in time than the ore deposits, that has usually been of great importance in protecting the veins from destruction. The mineralization follows nearly vertical fractures traversing both the sediments and the underlying andesite, but usually becoming smaller and tighter in the latter; the orebodies are usually confined to the sediments, the ore becoming scarcer, lower in grade, and more associated with base sulphides where the fissures have entered the andesite.

EL ORO-TLALPUJAHUA DISTRICT. The gold-silver mines

rango, Zacatecas, Guanajuato, and Queretaro to the States of Mexico and Hidalgo, was covered in early Tertiary time by a series of andesite flows of a considerable total thickness. Prior to this the topography had been deeply carved by the usual agencies, so that the andesite cap filled some old hollows and is thinner on old peaks. There is no evidence of mineralization of the shale to an important commercial extent till the returning volcanic activity of Miocene time brought the green andesite intrusives, which pushed their way into the shales horizontally, as laccoliths and sills. The disturbances to

the sediments due to these intrusions, as well as to subsequent cooling, caused extensive fracturing in both, nearly always as continuous fissures going through all the rock-members of the formation. Mineralizers issuing from the intrusive mass have reacted with the carbonaceous matter in the shale, depositing extensive bodies of silver-gold ore. These have then been cut by cross-fractures, causing a re-opening of channels and a circulation of mineralizing waters, so that secondary enrichment is an important factor in these deposits. The gold-silver ratio varies considerably: in some mines the amount of the silver is equal to that of the gold and there is therefore a great difference in their value; in others the money values of the two metals are about equal.

Perhaps the most useful structural basis for study of this class of deposits would be the change suffered by the mineralization in passing through the different kinds of rock that the fractures have cut through. The cap, which existed prior to the fracturing, has been faulted, but not mineralized. Nevertheless, the presence of a protecting cap on the deposits has been important, not only in saving them from destruction from surface agencies, but also for fundamental geological reasons. Circulation limited on the upper horizon means heavier deposition within the shales. There must have been, also, a difference in the origin of the fractures, due to the cap. Shale is not easily fractured in the mass, though brittle in small pieces; it yields to dynamic stress, bending with surprising elasticity, taking up movements and shocks, and closing behind them, leaving a bend instead of a crack, as in the more rigid limestone. There are no such enormous fractures and cave-openings in shale as are found in the limestone; only poorly defined circulation channels, albeit extensive ones. In the Central region, where the shale was capped by a sheet of andesite, the fracturing was stronger, owing to the resistance of the more rigid rock. The strata were twisted and torn out of place, with strong and extensive up-and-down movement of the fracture-walls, so that important circulation channels resulted, the adjacent shale being well shattered or loosened, and thus prepared for reaction with the elements of mineralization.

At El Oro, the three important rock factors are, beginning at the surface: the early andesite, purple-red in color, covering the El Oro deposits but eroded off the Tlalpujahua side, and varying in thickness from 90 to 810 ft., depending on the old topography. Next is the shale, from 500 to 900 ft. thick; black, thinly laminated, with every conceivable local variation in dip, and traversed by numerous quartz-filled fractures, some of which have become ore-veins. Below the shale is the green or recent andesite, occurring as a sill, in which profitable ore has not been found, about 1000 ft. thick; and finally, at a depth of 2200 ft. below the surface, the shale has again been encountered recently, with the natural hope of finding another enrichment.¹⁵

The Tlalpujahua half of the district lacks the cap over most of its area, and it may be noted, the silver content is of considerably more importance there than at El Oro.

At the extreme southern edge of the area occurs an interesting and extensive zone of brecciated shale, in which a little gold has been deposited, making a stockwork in which silicious solutions have circulated.

The most significant feature of the district is the large-scale faulting, which took place after the formation of the whole fracture system. See Fig. 11. Two heavy parallel fault movements, about a mile apart, traversed the ground nearly due east and west, cutting out a long and narrow fault-block, of which the Somera mountain forms today the high point. This fault-block was pushed up, and was attacked by agencies of erosion and degradation. The cap was worn away on the eastern and western slopes, making drainage lines of today. On the Tultenango or east side, we have a country of shale and clay soil, lacking ore deposits so far as known; on the west or Tlalpujahua side, the cap is gone except on the raised fault-block, leaving the shale of the Borda group entirely bare, for a long distance, well into Michoacan. As long as the miner remains in the fault-block in that region, he is in shale; as soon as he steps across either the north or Reforma fault or the south or Victoria fault, he finds himself again in the andesite, with hundreds of feet to go through before piercing the shale. Up to the present, prospecting in the shale outside the fault-block has been fruitless. It is only within the shear-zone formed in the fault-area that the mineralization has gone far enough to render exploitation profitable.

The veins, numerous and nearly parallel, run north-west, nearly at right angles to the direction of the great faults. The primary mineralization was performed by alkaline solutions, precipitating principally lime, and carrying little of the precious metals. Later disturbance caused considerable cross-faulting of these veins, enabling the re-entry of mineralizers. These solutions were highly silicious and rich in the precious metals. They circulated in the lime veins for long periods, thoroughly searching them, replacing with silica the minerals already formed, and enriching the deposits. That this replacement was carried out in great detail and perfection is conclusively shown by numerous pseudomorphs of quartz after calcite, beautifully formed, found in all the veins; that is, crystals which have every appearance of being calcite, but in which every particle of lime has been exchanged for one of silica, the original shape being preserved.

With the wearing away of the cap, and the circulation of surface waters in the cross-fault channels, secondary enrichment and oxidation came into play, and made the deposits of the Esperanza, El Oro, and Mexico mines, remarkable for both extension and richness, accompanied by extreme irregularity both in the occurrence of the ore-bodies and in the distribution of their valuable contents. Fig. 10 shows the general relations of the rock-members and veins in these deposits.¹⁶

We have then, in these deposits, at least three well-defined stages of mineralization, similar to those that were noted in the mines of the San Pedro district: first, a primary alkaline mineralization, depositing calcite crys-

¹⁵Courtesy of A. F. Main, El Oro M. & Ry. Co., Mexico City.

¹⁶Annual report, El Oro Mining & Railway Co., 1913.

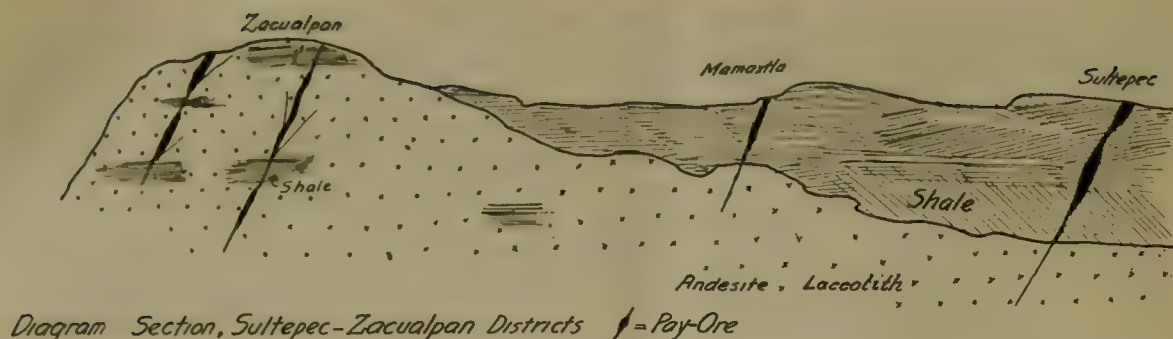


FIG. 13. SECTION FROM ZACUALPAN TO SULTEPEC

tals in more or less open channels, with low gold content; second, later silicious mineralization, coursing through the same channels and replacing the lime, which silicious solutions introduced important amounts of the precious metals; and lastly, the coming in of meteoric waters due to the penetration or removal of the cap, and consequent oxidation and secondary sulphide enrichment. The cap, by eliminating the influence of surface agencies at least during the early part of the life-history of the El Oro deposits, narrows the problem of origin of mineralization down to emanations coming out of a deep-seated igneous

source, wholly within the limits of the fault-block.

It cannot be said that the association of the intrusive with the ore deposits is as intimate in the case of the El Oro examples as in that of a true contact deposit like Barreno; it is, however, sufficiently obvious that the intrusive furnished from its magmatic emanations at least the rudiments of the deposits. The fact of the shale forming the horizon of deposition practically to the exclusion of the underlying andesite, suggests comparison with such a true contact deposit as Ajuchitlan, where precipitation of metallic salts from magmatic solutions took place, never immediately on the contact surface, and never inside the intrusive, so far as known, but always in a zone from 25 to 50 m. removed from the contact, and hence wholly within the shale. See Fig. 12.

SULTEPEC-ZACUALPAN DISTRICT. Less known examples, but very interesting ones, are to be found in the Sultepec district. For reasons that will suggest themselves, the names of some of the properties concerned in the following discussion will not be given. See Fig. 13.

The El Oro shale continues south into the State of Guerrero, with local interruptions, and with the same or a similar intrusive underlying them. There is, generally speaking, no cap. The intrusive is the same green andesite, which has pushed its way into the shale strata for long distances, reaching its highest point of elevation in the Zacualpan district. The shale, from 300 to 600 m. thick, is cut by numerous fracture-systems, in which quartz, calcite, and most of the base sulphides have been deposited, with varying amounts of silver and sometimes considerable gold.

The history of mining development in this shale has thus far been practically the same. Rich gold-bearing silver ores are found in pockets near the surface, which continue down in the form of chimneys till the andesite is reached. The veins then become impoverished, and the fractures generally, though not always, diminish in size, usually tightening considerably. Occasional spots of enrichment are found, carrying clean crystals of argentite, stephanite, and the ruby-silver minerals, but as yet no real orebodies have been developed at this horizon. In one of the extensively developed mines of the Sultepec district, pyrite ores carrying gold as the principal metal, but with an appreciable silver content, occurred in long bodies over several hundred metres of

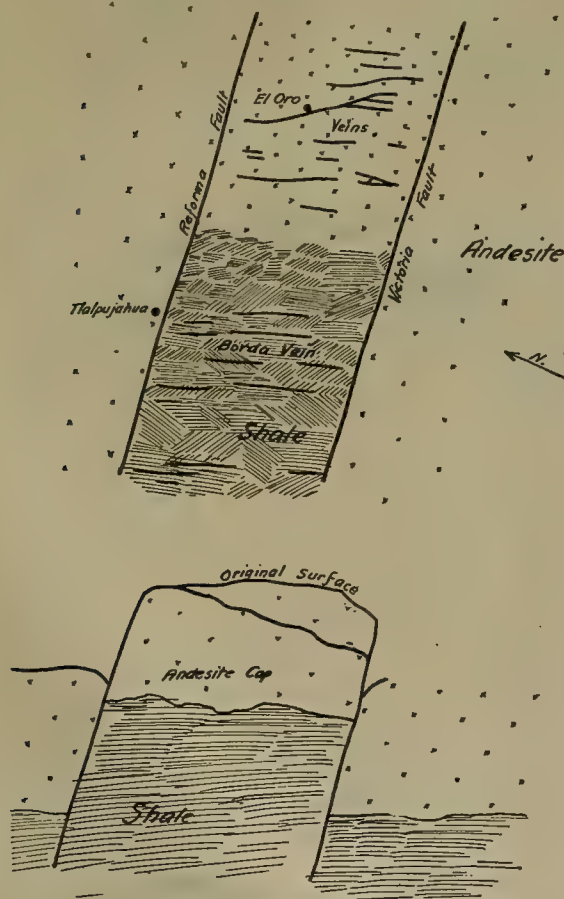


FIG. 11. THE EL ORO-TLALPUJAHUA FAULT-BLOCK

lateral development, in the shale. Exploration downward on these ores has reached the andesite horizon and a certain amount of work has been done to a depth below the shale of about 200 ft. So far there have been no favorable developments. In another mine, near the Indian village of Mamatla, in Guerrero, about half-way

surface. Meantime, sinking on the orebody was carried on from the tunnel-level down toward the andesite. In spite of a slight enrichment at the horizon of change, it soon became evident that the ore was becoming poorer, and after about 25 m. of sinking, with the vein still strong, the ore practically disappeared. Confirmation

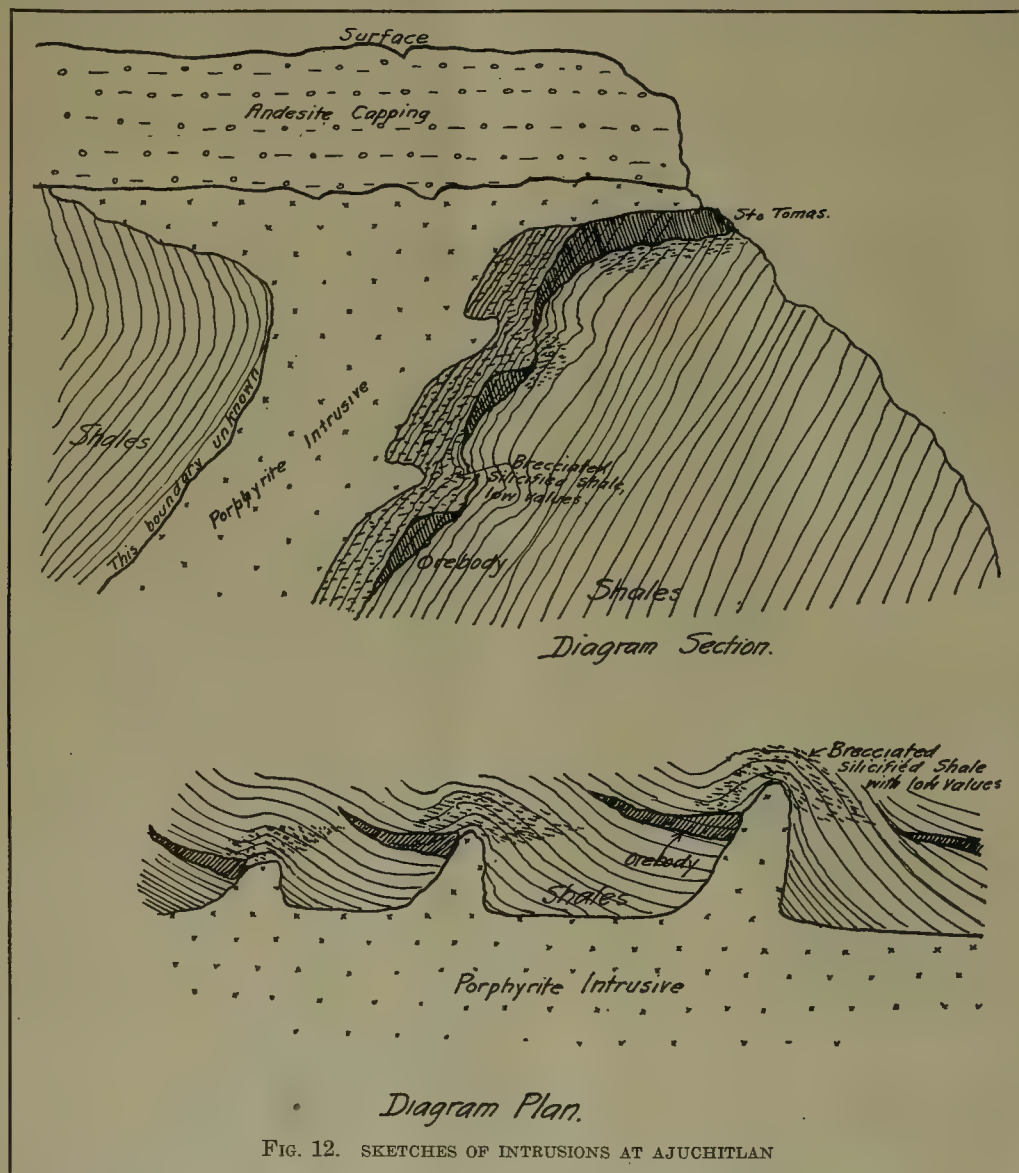


FIG. 12. SKETCHES OF INTRUSIONS AT AJUCHITLAN

between Sultepec and Zacualpan, the geologic conditions were worked out with great exactness with the same result. An enriched pocket, in the shale, yielding exceedingly high-grade silver ore with some gold, was discovered by means of a tunnel about 40 m. above the andesite, which outcrops in contact with the overlying shale on the steep hillside. The ore was stoped upward until *antigua* workings on the same chimney were reached, the mineralization being continuous up to that point and having formerly existed from there to the

was sought by utilizing an old opening below, entirely in the andesite. This was carried forward to a point below the workings mentioned, the veins persisting and showing an occasional lump of rich and clean ore of the type found in the Zacualpan district proper, but as a whole the exploration was unproductive and had to be abandoned.

A more striking example of the same facts, occurring at the edge of the Zacualpan district, but geologically still in the Sultepec formation, is to be seen in the case

of a certain *antigua* that became the object of a well-known local stock-flotation. An expensive mill was erected to treat the ore remaining from former operations, prior to development in depth. The known orebodies were entirely in the shale just as in the cases described. When milling began, sinking on the old orebodies soon reached the andesite, with such an impoverishment as to make the operation unprofitable. The enrichment had clearly been only in the shale, of secondary nature, and the former workers had thoroughly understood the conditions and confined their operations to the shale.

The conditions in this and adjoining mines are complicated by the presence of recent dikes of a dark basic rock, very hard, and from one to ten metres thick, which cross the older veins at acute angles and with about the same dip, that is, from 60° to 75° . These dikes have brought in considerable iron sulphide and some copper, which in the case of a few intersections occur in small orebodies. On the whole, the dikes have not been a benefit to the deposits.

The most important property in this particular area, and one frequently mentioned locally as being in the Zacualpan district, is the old Carboneillo, out of which a notable orebody was extracted beginning about 15 years ago. The occurrence illustrates perfectly the conditions under which enrichment is likely to take place in the mines of this area. There are four principal veins in the mine, all from 50 cm. to a metre wide, all vertical in dip, and coming together at an acute angle under the old caved workings of the surface. A cross-cut tunnel was driven to cut all the veins and a little ore was taken out in exploring them, in small lenses; nothing of importance, however, was found until one of the workings was driven toward the intersection of the veins. An immediate improvement in width and grade ensued, and the ore was followed into a rich orebody, from which for several years good ore was taken out. These orebodies were entirely in the shale.

Study of these typical cases, with the intermediate variations that occur in the district, has convinced me that while exploration in the andesite is necessary and well worth while, a barren zone certainly occurs in the andesite immediately at its contact with the shale, and that the probabilities are rather against finding orebodies of any size at great depth. Ore can be found, but the veins change their character and the mineralized spots are few and far between. The fundamental principles of ore deposition which we have been following in these examples show us that where fractures diminish in size with depth and the formation becomes drier and tighter, it is not likely that favorable conditions obtained for the deposition of mineral from solutions.

ZACUALPAN DISTRICT. If we follow the above formations into the Zacualpan district proper, we find the shale subordinated and the mineralization strongest in the andesite, and this without any break in the continuity of the intrusive; that is, the enrichment that in the one district takes place in the overlying sediments, in the other

takes place in the underlying andesite. The difference is largely physiographic; much of the enrichment in both areas is secondary in its nature, depending on the circulation of meteoric waters along the fractures. Where the andesite is deeply buried, secondary enrichment has not reached it to an appreciable extent; where, as in the Zacualpan district proper, the andesite pushed its way to the surface, mineralized fractures in the formation have been affected by secondary enrichment and valuable orebodies formed. As this area comes under the classifi-

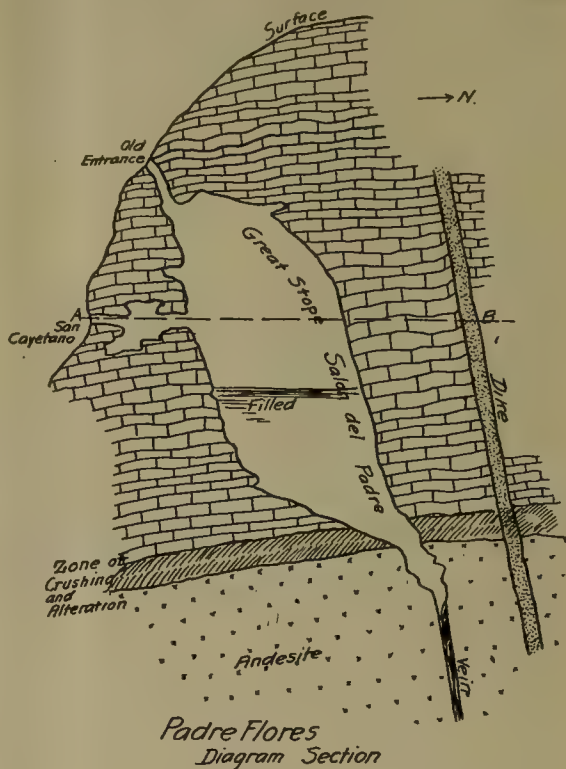


FIG. 14

cation of ore deposits in eruptive rocks, I shall leave its discussion for the present. The characteristic changes that appear in tracing the orebodies from the shale through the andesite, make the district a most interesting one to the student; and it has been for three hundred years not less so to the miner, having maintained an intermittent production from Spanish times to the present, without important outlays of capital.

BENITO JUAREZ DISTRICT. An interesting example of mineralization in shale influenced by a near-by intrusive is to be found at Salinas, in Zacatecas, in the Benito Juarez mines. These gold-silver veins occur in shale, considerably disturbed, near Salinas, where the famous salt deposits are situated. The most prominent topographic feature of the district is the Peñon Blanco, a high mountain five kilometres from the deposits. Peñon Blanco is composed entirely of a light-green andesite, which has pushed through the sediments after the first fractures had formed, and has caused the re-opening of

the ground by a second series of cross-fractures, making an angle of about 60° with the first group. This second system of fractures has a strong quartz filling, with highly enriched gold ores at the points of intersection with the older veins. Outside the intersections, the gold contents are low, sometimes for long distances.

Between these mines and the Peñon occur a few prospect-holes on the quartz veins, showing much purely secondary mineralization such as is found in contact deposits. If some of these fractures could be followed down, they would probably show contact with some intrusive body connected with the Peñon mass. As it is, there seems to be no doubt that the gold in the Benito Juarez veins came from recent silicious solutions having their origin in this intrusive mass, and making deposition at such a distance from it as to appear independent of intrusive influence.

COMBINATION FORMS. An extraordinarily interesting series of ore deposits is found at Catorce, in San Luis Potosi; in these all the features of deposits in sedimentary rocks are combined with a continuation of the fractures and the ore into the underlying andesite. The district is one of the oldest in Mexico and has been productive of high-grade silver ores, the old Concepción, La Luz, and San Agustín mines having been important for generations.

The Catorce formation is made up of three principal rock-members; first, the blue Cretaceous limestone, in which the veins have formed large irregular pockets and in which the early miners found their bonanza ores; second, the dark andesite underlying these sediments and forming the foundation of the Catorce uplift, which reaches an elevation of 9000 ft. above sea-level. The silver veins of the district, from half a metre to several metres wide, go down through the limestone into the andesite and have been worked for several hundred feet below that horizon. Finally, both limestone and andesite have been intruded by numerous dikes, usually cutting obliquely across the veins. These igneous dikes, known as 'porphyry' in the district, are from a few centimetres to several metres thick, of a more silicious nature than the andesite itself, but presumably an end-product of the same magma that made the andesite. I have not determined the dikes petrographically. That they have had an enriching influence of the highest importance, seems to be indisputable. The silver veins are not enriched sufficiently except near these dikes, there being long stretches of nearly barren ground between the inter-

sections. Approach to a dike in the course of exploration is nearly always accompanied by a rise in the grade of the vein-filling, as well as by increased width of mineralization, and all the high-grade orebodies have been found close to the dikes.

The andesite is an enormous mass, affecting the whole district for miles around and plainly visible on the surface in the immediate neighborhood of the Real de Catorce underlying the limestone. The sediments have been worn away into rounded light-colored caps on top of the darker igneous rock, so that the structure is readily visible from a distance. The limestones are 300 to 500 ft. thick; the andesite, from 1000 to 1500 ft. at least, probably going still deeper. The whole uplift rises out of

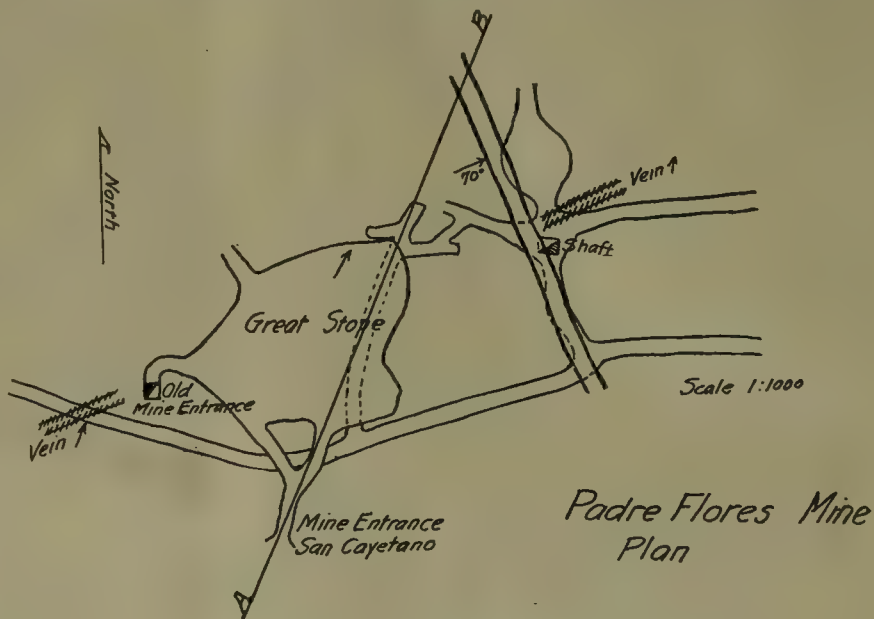


FIG. 15. PLAN OF PADRE FLORES MINE

the detritus of the Catorce plain in abrupt fashion, making a mountain wall that extends about 15 km. south to the Wadley antimony deposits, which must be regarded as within its zone of influence.

PADRE FLORES MINE. The accompanying drawings (Fig. 14 and 15) show workings in an old silver mine of the district, to which tradition assigns a fabulous production during Spanish times. The section shows the relations of the vein-fractures to two different country-rocks, as well as to the near-by dike. The old stope is an impressive sight from the San Cayetano workings, which enter it high above the floor; it is in all respects similar to the great caves of the Barreno and similar lead mines, being a long, rambling, irregular chamber in the limestone, formed by extension of replacement from a central fracture across the bedding of the strata, and going down almost vertically. It is about 100 ft. long, 60 ft. wide, and about 250 ft. deep, its bottom being lost in the zone of decomposed white material found at the contact of the limestone with the andesite. From the chamber itself go off old workings on the strata in a few places, where

during the period of mineralization the limestone offered favorable conditions for the formation of replacement orebodies. Such was evidently the San Cayetano working through which one enters the chamber from the surface. The great stope and its subsidiary bodies have all the characteristics of the true contact orebodies: size, shape, position with reference to the andesite, and relation to mineralizers coming from the latter, as well as the fact that the ore carried considerable lead and some zinc.

The vein associated with this remarkable orebody was followed down to a depth of over 300 ft., the mineralization being about a metre wide and yielding a little ore. It has never, however, in any degree approached the magnitude of the old Salon del Padre, and the very heavy flow of water, to be handled only by the best modern pumping machinery, has hindered further exploration in depth, just as it has in the more important properties of the district. In these, however, while the orebodies in the limestones were also of much more importance than those in the andesite, the latter have been profitable; in such a mine as Concepción de Catorce, for example, the vein is several metres wide even in the andesite, so that in spite of the undoubted diminution in width and value on entering the lower horizon, it has been possible for the larger mines of the district to operate profitably at depth, even though handicapped by the strong flow of water.

SUMMARY. There seems to be no doubt that in this district, more favorable conditions for deposition were found in the sediments than in the andesite, in which respect it is like the ore deposits we have just been studying; but unlike those, the enrichment in the Catorce deposits has continued into the igneous rock for great depth, making mining profitable in the andesite also. To what depth the mineralization may extend is not known.

The difference between these deposits and those of the shale in the El Oro and Sultepec districts is therefore a great and a vital one. The most obvious difference in structure is the presence of the numerous porphyry dikes and their undoubted influence in enriching the deposits locally. In Padre Flores, for instance, where but one important orebody was found, only two dikes have been observed; whereas they are numerous in all the better-known mines of the district. It may well be that these porphyry dikes, undoubtedly a later separation from the same magmatic structure out of which came the mineralization of the veins, may have re-established a connection with the interior of the mass, re-opening the partly mineralized veins, and bringing in later the silver-bearing solutions that attacked the andesite in somewhat the same manner as the limestones. This would depend largely on the nature of the andesite, which is totally different from the green eruptive of the Sultepec district, although certain alteration phases give it the same color. The unaltered rock is similar to the reddish-purple andesite of the Hostotipaquillo region in Jalisco, in which important silver mines exist.

A MIXTURE of 70.3% antimony, 21.2% sulphur, 1.14% iron, and a trace of silica—the whole being the resultant

product of ore which has been subjected to the process of metallic fusion known as 'liquation'—constitutes material containing antimony and is dutiable under paragraph 144 of the tariff act, according to a recent ruling of the Board of Customs Appraisers.

Diamond Mining in Africa

Diamond mining is the principal industry in South-West Africa. Diamonds were first discovered in 1908, during railway construction, in the valley sands of the coastal desert, and have since been recovered over a stretch of 270 miles between latitude 28° and 24°S. However, there are wide intervals where no stones have been found, and none have been discovered at a greater distance than 15 miles from the coast. Various theories have been advanced as to the origin of these diamonds, but the theory to which facts appear most satisfactorily to lend themselves is that the diamonds are of sea origin. It is generally believed by geologists that primary deposits exist under the sea within the area between Possession island and Pomona on the mainland. The stones already found by dredging in the sea are believed to have been thrown up on the floor of the ocean by volcanic action, while the stones on the mainland, according to this theory, have been washed up and carried by the wind in the drifting sand dunes. Another fact which geologists believe substantiates their theory is that the largest stones hitherto found have been picked up just south of Pomona, which indicates that the centre from which the gems were distributed is situated in closer proximity to the southern part of the Pomona claims than to any other section of the fields. Taking everything into consideration, they are led to believe that the South-West African diamonds have been derived from primary deposits that lie buried beneath the sea, somewhere in the neighborhood, and evidently to the south, of Pomona. Experts are agreed that the diamonds are unlike those of any other known source—primary or alluvial—in the Union of South Africa. This view is endorsed by the Antwerp and Amsterdam cutters, who maintain that the stones in hardness and other physical properties more closely resemble the product of the Brazilian fields. They are characterized by great brilliancy, even in the uncut state, and the quality is remarkably good. This accounts for the fact that, notwithstanding their diminutive size, great numbers of these stones have been absorbed by the world markets. In weight the diamonds range from 1/20 to 34 carats. The average size of diamonds produced in 1913 was 1/2 carat. The largest stones have been found in the Pomona and Ida Tal area. As regards color, diamonds of almost every conceivable hue are represented. Blue-white stones occur, but are on the whole rare. On the other hand, clear white crystals are very common and make up the bulk of the output. Many yellow, pink, dark red, purplish, bluish, green, and black stones are also found. During 1913, the last full year before the War, the production amounted to 1,284,727 carats, valued at \$13,132,250.

Initial Velocity of Bubbles in a Pneumatic Flotation-Cell

By MELVIN S. DONALDSON

INTRODUCTION. Considerable discussion and difference of opinion have arisen in regard to the velocity of bubbles produced in a flotation-cell of the pneumatic type. In order to determine the behavior of these bubbles by actual demonstration, the following tests were performed as part of the course in mining at Stanford University. In the past certain flotation authorities have maintained that in the operation of pneumatic machines the bubbles leave the canvas, or other porous medium, with an initial velocity imparted to them by the pressure of the air in the space underneath the bottom of the cell; in other words, that these bubbles do not start on their upward journey from a state of rest. It is also contended that

tests were made and the paths of the bubbles photographed and their action studied when produced by various pressures.

APPARATUS. In order to carry out the observations, it was necessary to construct an apparatus that would correspond to a small one-compartment cell, so that the performance would be similar to that produced under actual working conditions. The device used in this series of tests was simple in construction. A cylindrical piece of wood 3 in. diameter and $2\frac{3}{4}$ in. long was hollowed out (Fig. 1) and two thicknesses of 10-oz. canvas were fastened by means of a metal band over the open end. The walls of this wooden cell were cut down thin, so that the

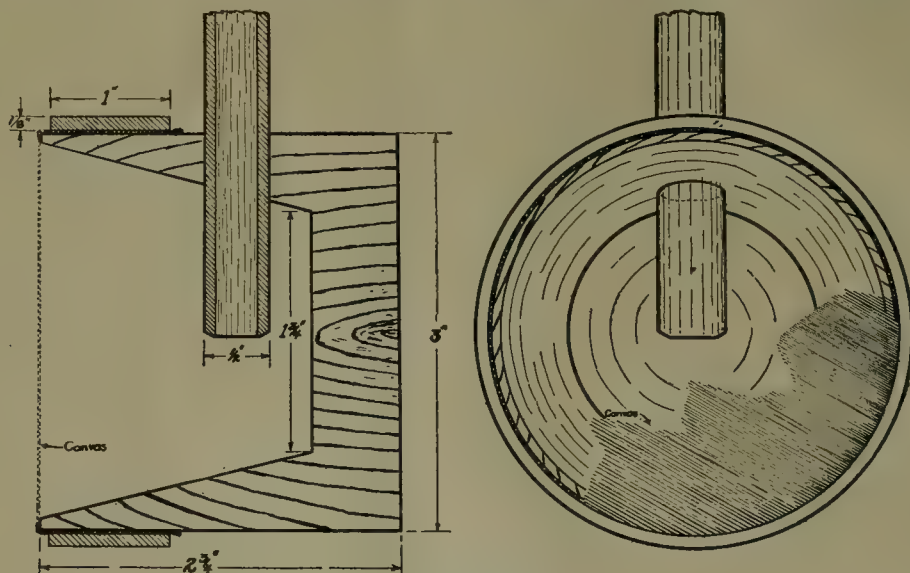


FIG. 1. CONSTRUCTION OF 'CELL'

this velocity or impulse is directly proportional to the pressure. On the other hand, there are those who are firm in their belief that, within the limits of pressure employed in practice, the bubbles released at the canvas surface have no initial speed and that an increase in the pressure of the air supplied to the cell will not tend to increase the velocity of the ascending bubbles.

If the former theory is correct, that the bubbles do have a varying initial velocity, depending on the pressure under which the cell is working, then if the porous medium at the bottom of the cell is placed in a vertical, instead of a horizontal, plane, as is the case in a Callow cell, there will be two components of velocity, namely, the vertical component, caused by the buoyancy of the water, and the horizontal, due to the initial velocity. In order to prove whether or not this velocity exists the following

entire area of the canvas might be subjected to the air-pressure behind it. Care was taken to see that the only means of escape for the air in the apparatus was through the porous medium. By means of a $\frac{1}{2}$ -in. iron pipe and rubber tube the chamber in the wooden block was connected to an air-blower with a mercury-column pressure-gauge interposed. This apparatus was placed in a four-sided glass vessel containing ordinary tap-water. A paraffine-coated co-ordinated chart, divided into twentieths of an inch, was mounted in the water immediately behind. It was thought that the actions and movements of the bubbles could be accurately transferred to paper. However, it was soon found difficult to observe precisely the exact size and actual path of the bubbles and to picture on paper the movements of thousands of them, so that after a few experiments with a camera the black

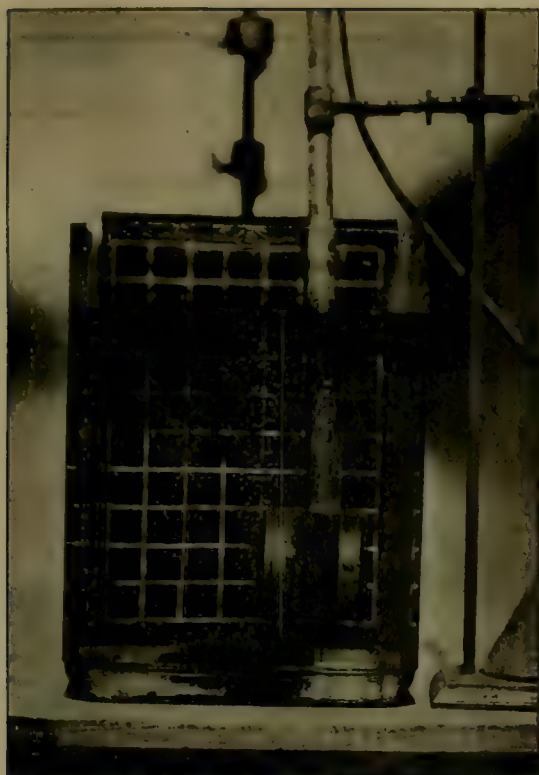


FIG. 2. NET PRESSURE, 0.50 INCHES



FIG. 3. NET PRESSURE, 1.50 INCHES



FIG. 4. NET PRESSURE, 3.50 INCHES



FIG. 5. NET PRESSURE, 14.00 INCHES

chart ruled in one-inch squares with white ink was substituted and clear distilled water was employed instead of opalescent water. The accompanying photographs were taken at a speed of 1/260 of a second with a special Graflex camera. They compare the action of bubbles under pressures of air varying from 0.50 to 14.0 in. of mercury, the latter being much higher than is used in practice. The term 'net pressure' refers to the amount in excess of that necessary to displace the water in the cell and overcome the resistance of the apparatus, which amounted to 2.35 in. of mercury. In milling practice the pressures range from 8 to 10 in. of mercury (4 to 5 lb.), including the pressure that is necessary to offset the hydrostatic head and the resistance of the air between the pressure-gauge and the outer surface of the canvas, which will vary from two to four inches of mercury. Some of the pressures used in this experiment are well within the limits of practice, while others are much higher than would be used in a cell.

RESULTS. These experiments conclusively prove that there is no difference in the velocity of the bubbles due to any increase or decrease of air-pressure within the limits ordinarily employed in milling. Attention is called to the photographs; a close inspection of them, particularly the lowest one-half inch of the canvas, reveals no sign of a horizontal path of the bubbles. None shows any horizontal component of force, or that force which would give the bubbles an initial velocity. Any departure of a bubble from its natural vertical path is caused clearly by the crowding of a larger number of bubbles extruded under the higher pressures.

In the case of a pneumatic flotation-cell, the porous medium, whether it be canvas, porous brick, or cement, acts as a fine subdivider for the air and also to some extent as resistance. Microscopic examination of the canvas used in this experiment shows that there is on an average about 1000 holes per square inch available for the passage of air between the threads of the fabric. The pressure from the air-blower forces the air in fine streams through these less resistant parts of the porous medium. Where a decidedly low pressure (Fig. 2) is used only some of the most easily penetrated holes in the medium act as conduits for the bubbles, and as the pressure is increased this number becomes correspondingly greater.

As these streams of air emerge into the water they form bubbles that are released individually from the rest of the air, when the buoyancy of the water is greater than the surface energy required to form the bubble. It is evident that if the working-pressure of the cell is doubled, twice the amount of air will pass through the canvas. As the pressure is increased within the limits of usual practice the number of bubbles is correspondingly increased. It was also noticed that bubbles rarely combine to form larger ones, but seem rather to repel each other. The photographs illustrating the higher pressures show the formation of so many bubbles that there is crowding and a tendency to shove some of the bubbles half an inch or so away from a vertical path. The extreme pressures, observed in some of the experiments,

caused a violent 'bumping' at the surface; and it is quite possible that some of the small bubbles collide, join together, and form larger ones. While it is true that these larger bubbles do travel upward with a greater velocity, there is no initial velocity. Such turbulent action would be unsuitable for the flotation of mineral. It is evident that this horizontal displacement and crowding cannot be mistaken for a horizontal component of velocity.

The object of photographing the paths of the bubbles was to show that they are not shot out with an initial velocity from the bottom of the cell, but that any departure from their normal paths is caused by the crowding. I conclude that to increase the pressure in a pneumatic cell simply causes more air to be liberated, the number of bubbles being increased thereby. There is lacking any force, save that of the buoyancy of the water, to give the bubbles anything resembling an initial velocity.

Petroleum in Czechoslovakia

Petroleum is found in two regions in Czechoslovakia, adjoining the Carpathians on the east in Slovakia and on the west in Moravia. The oil-fields of Slovakia are undoubtedly large, but have not been investigated sufficiently to permit of reliable estimates. In Slovakia drilling for petroleum is a State monopoly. The principal wells are found near Gbely, a small town of 3000 inhabitants, on the Kutý-Holíč railway line, in the district of Nitra. This territory formerly was under Magyar domination. When it was taken over by the Czechoslovak Republic at the beginning of 1919, well No. 68 was about to be completed, while the drilling of three other wells was unfinished. At the end of 1919 well No. 82 was being bored and three other wells were being started, showing that considerable work had been done in 1919, notwithstanding the unfavorable conditions. The Gbely wells yield a heavy oil which is employed as a lubricant and has replaced the so-called vulcan lubricating oil formerly imported from Galicia. For the present the borings are confined to the Sarmatian strata. The wells are about 200 ft. apart, averaging about 835 ft. in depth. The Sarmatian oil is heavy, having a specific gravity of 0.930. The older Oligocene strata of the Tertiary formations have not been tapped as yet. A comparison with the Galician fields shows that those of Slovakia have not been explored sufficiently, for in Galicia the borings are only 130 ft. apart and the wells reach to a depth of as much as 4600 ft., at Tustanowice even to 5250 ft. Preparations are now being made at Gbely for the boring of the first deep well. Two different methods of boring are employed at Gbely, the choice depending on circumstances: the so-called 'flushing' method, and the 'dry' method based on the system of Tauk and Franzl. The flushing method possesses many advantages over the Canadian method, which is generally employed in Galicia, the chief one being the lower cost of equipment. It is said that the flushing method is much more economical, its effectiveness in comparison with the Canadian method being in a ratio of 6 to 1.

The Analysis of Magnesite

By W. C. RIDDELL

INTRODUCTION. Numerous inquiries have come to the Berkeley Experiment Station of the U. S. Bureau of Mines relative to the analysis of magnesite and magnesite products. Accordingly it seems desirable to publish a description of the method used at this laboratory in making the analyses required in the investigation of magnesite technology as conducted by the Bureau in co-operation with the Northwest Magnesite Co. Special attention has been given to the separation of calcium from magnesium.

A number of possible methods for the separation of calcium from magnesium have been reviewed by Kallauner and Preller.¹ These authors conclude that the oxalate method is the most satisfactory. They state that when the oxalate method is used on material containing approximately 50 parts of MgO to one part CaO, the error in the determination of CaO will be from 0.15 to 0.2% low. The experimental results in this laboratory indicate that with care this percentage of error may be reduced considerably. The article cited contains a full discussion of the various factors influencing the results.

The method of analysis outlined herewith is based on suggestions given by Brearley and Ibbotson,² for the analysis of basic material. The use of rosolic acid as an indicator is suggested by the work of Blum.³

This method has been in use in this laboratory for some time and the results have been checked by several operators. Some experimental data are appended showing the influence of various factors on the separation of calcium from magnesium.

METHOD OF ANALYSIS. For the analysis of crude magnesite a sample of one gramme is used; for the analysis of 'dead-burned' magnesite, 'ferro-magnesite', magnesia brick, and caustic magnesia a half-gramme sample is sufficient. The weighed sample in a 250-cc. pyrex beaker is moistened with cold water to avoid lumping, and 15 to 20 cc. of hydrochloric acid (sp. gr. 1.2) is added. Digest on the hot-plate and evaporate finally to dryness, continuing the heating until the silica is dehydrated. Heating in a drying-oven at 110° to 120°C. for half an hour is a convenient method of dehydrating the silica. To the residue add about 30 cc. of hydrochloric acid (1:1) and digest until all of the soluble salts are dissolved. Dilute with hot water to a volume of about 100 cc., filter the insoluble residue of impure silica, wash with cold water, and then with hot water until free from chlorides. The residue is ignited, weighed, and reported as 'insoluble'.

In order to determine the silica exactly the insoluble residue is treated in a platinum dish with hydrofluoric acid and a few drops of sulphuric acid and the silica-free residue is ignited and weighed. Care should be taken to heat the crucible to a temperature of at least 1000°C., as the residue generally contains magnesium sulphate which will not be decomposed at a temperature much below this. The residue from the volatilization of the silica is dissolved in hydrochloric acid, or fused with sodium hyposulphate if necessary, and added to the main filtrate.

To the filtrate from the insoluble residue add 7 to 8 gm. of ammonium chloride, dilute to about 200 cc., add macerated filter-paper and a few drops of rosolic acid as an indicator. Heat nearly to boiling, remove from the hot plate, and add ammonia in slight excess as indicated by the change in color of the indicator from yellow to pink. Filter immediately and wash with hot water, containing about 10 gm. of ammonium nitrate per litre, until only a faint opalescence appears on testing with silver nitrate. The washing of the hydroxides when precipitated in the presence of macerated filter-paper is readily accomplished. Ignite and weigh the precipitate, which consists principally of the oxides of aluminum, iron, and manganese.

Make the filtrate acid with hydrochloric acid, add 40 cc. of a saturated solution of ammonium oxalate, dilute to about 400 cc., heat nearly to boiling, remove from the hot plate, and add a slight excess of ammonia. Allow to stand for about one-half hour. Filter off the precipitate of calcium oxalate, wash two or three times with hot water, and then wash the precipitate back into the beaker, making sure to wash the filter-paper thoroughly.

Re-dissolve the precipitate with 5 cc. of hydrochloric acid, add about 5 gm. of ammonium chloride and 5 cc. of ammonium oxalate solution, dilute to about 200 cc., heat to boiling, neutralize the solution with ammonia, using rosolic acid as an indicator, and boil three to four minutes. Remove from the hot plate and allow to stand for about 15 minutes. Filter and wash the precipitate with hot water until free from soluble oxalates. Dissolve the precipitate in about 100 cc. of hot water to which 10 cc. of sulphuric acid (1:1) has been added, heat nearly to boiling, and titrate with 0.05 to 0.02-normal solution of potassium permanganate, which has been standardized with sodium oxalate from the Bureau of Standards.

Magnesium is determined in the combined filtrates from the calcium determination by diluting to a convenient volume, dividing into aliquot parts, and precipitating as the phosphate. Calculation of the magnesium oxide by difference is generally sufficiently accurate.

Iron is determined by the dichromite or permanganate

¹Kallauner, O., and Preller, I. 'Chem. Zeitung', No. 36 (1912), pp. 449 and 462.

²Brearley and Ibbotson, 'The Analysis of Steel-Works Materials', pp. 220 and 221.

³Blum, W. 'Determination of Aluminum as Oxide', Jour. Amer. Chem. Soc., No. 38 (1916), pp. 1282-97.

method, using a two-gramme sample, and is generally reported as ferric oxide.

Manganese is determined by the Volhard or bismuthate method.

Ignition loss is determined by heating at approximately 1000°C. for from 20 to 30 minutes.

EXPERIMENTAL DATA. The experiments recorded in Table I were made with a standard chloride solution prepared from pure calcium carbonate and magnesium chloride. The solution contained 0.009 gm. of magnesium and 0.0002 gm. of lime per cubic centimetre. For each experiment 50 cc. of this solution was used corresponding to 0.450 gm. magnesia and 0.010 gm. of lime. These quantities correspond to a one-gramme sample of magnesite or a half-gramme sample of calcined material.

The following conditions apply to all these experiments: volume used for first precipitation, 400 cc.; ammonium chloride added for first precipitation, 8 gm.; saturated solution of ammonium oxalate added 50 cc.

The following conditions apply to experiments No. 4, 5, and 6: volume used for second precipitation, 200 cc.; ammonium chloride added for second precipitation, 5 gm.; saturated solution of ammonium oxalate added, 5 cc.

magnesia. In experiment No. 5, where double the amount of magnesium was present, the result for lime on a single precipitation is distinctly high, being 0.0229 gm., as against a theoretical 0.0200 gm. These results, together with those in Table I, indicate the limiting concentration of magnesium in solution beyond which a double precipitation is necessary.

The results obtained by several different operators with the method described on three samples of magnesian material are given in Table III.

TABLE III

Sample Analyst	Dead-burned magnesia			Raw magnesite			'Ferro magnesite'		
	W	1	2	S	M	R	1	R	2
Insoluble	9.7	9.85	9.70	4.65	4.61	4.65	4.80	4.74	
True SiO ₂		8.35	8.40	No determination			4.34	4.32	
Al ₂ O ₃							0.42	0.34	
Mn ₂ O ₃	1.0	1.11	1.08	1.59	1.70	0.41	0.92	0.92	
Fe ₂ O ₃	5.4	5.52	5.50	0.92	0.93	0.96	6.20	6.24	
CaO	1.4	1.48	1.54	2.80	2.80	2.76	0.56	0.48	
MgO (by diff.)	83.3	83.5	83.4	41.29	41.95	42.52	82.54	82.74	
Ignition-loss	0.3	0.3	0.3	48.75	48.01	48.70	0.22	0.22	

Graphite in Western Australia

Western Australia is fortunate in possessing one of the largest remaining known graphite deposits of the

TABLE I

No.	Time for first precipitation	Number of precipitations	Time for second precipitation	0.1 N KMnO ₄ solution used, cc.	CaO found, gm.	Error, gm.
1.	Boiled 5 min.	1		22.8	0.0784	+ 0.0684
2.	Heated to boiling and allowed to stand 30 min.	1		35.0	0.0980	+ 0.0880
3.	Heated to boiling and allowed to stand 60 min.	1		23.9	0.0669	+ 0.0569
4.	Boiled 5 min.	2		3.5	0.0098	- 0.0002
5.	Heated to boiling and allowed to stand 30 min.	2	Boiled 2 min., allowed to stand 10 min.	3.45	0.0097	- 0.0003
6.	Heated to boiling and allowed to stand 60 min.	2	Boiled 2 min., allowed to stand 5 min.	3.2	0.0090	- 0.0010

It is evident from the first three experiments that with a single precipitation the results for lime are wrong. If the solution used for analysis is considered as representing a half-gramme sample of calcined magnesite, the corresponding lime content equals 2%. Calculating on this basis, experiments No. 4, 5, and 6 show 1.96, 1.94, and 1.80% lime respectively, an average error of -0.10%.

For the experiments recorded in Table II, a solution containing 0.003 gm. of magnesia and 0.0002 gm. of lime per cubic centimetre was used.

The following conditions apply to all experiments: volume used for precipitation, 400 cc.; ammonium chloride added, 8 gm.; saturate solution ammonium oxalate added, 40 cc.; number of precipitations, one.

TABLE II

No.	Standard solution used, cc.	Time for precipitation min.	Deci-normal potassium permanganate solution used, cc.	CaO found, gm.
1	50	30	3.5	0.0098
2	50	60	3.4	0.0096
3	50	boiled 3 min.	3.45	0.0097
4	50	30	3.3	0.0093
5	100	60	8.2	0.0229

It will be noted that in experiments No. 1 to 4 the average lime found was 0.0096 gm., as against a theoretical recovery of 0.0100 gm. In these experiments the 400 cc. of solution in which the precipitation was made contained magnesium chloride equivalent to 0.1500 gm.

world, and the Minister for Mines has announced that an English company is about to exploit it on a large scale. In the past this graphite has been considered worthless, but the extending uses, contracting supplies, and improved methods of treatment are making it profitable to mine lower-grade material. The chief uses are for pencils, the protection of iron surfaces (as in stove and other polishes), for making sundry refractory articles, such as crucibles, for lubricants, and for 'facing' or glazing gunpowders, says 'Chemical Engineering and Mining Review'. Brodie's process is principally used for the purification of inferior graphites. In this, the graphite is treated with sulphuric acid and a little potassium chlorate, and oxidized to graphitic acid, C₁₁H₄O₅. The treated product is then washed, dried, and heated to redness; the graphitic acid is decomposed, and the graphite remains as a light, bulky powder, which can be separated from impurities by floating it away with water. When silica is present in great quantity, a little sodium fluoride is added after the potassium chlorate has been decomposed. Graphite of any desired purity can be formed in the electric furnace with the aid of silica, alumina, magnesia, or lime, which first form carbides and later distill into the cooler parts of the furnace. This process, however, is not likely to be used while natural deposits of graphite are available, on account of its comparatively high cost.

An Improved Wedge for Deflecting Diamond-Drills

By C. ERB WUENSCH

PURPOSE OF THE DEVICE. The scheme of deflecting diamond-drills by means of a wedge is not new; but the operation according to present practice is tedious. The position of the pilot wedge must be accurately surveyed for each deflection, and the wedge itself cannot be recovered; it serves for only one deflection. This consumes time and is expensive as compared with the method that can be used with the device to be described. It is possible to take a number of samples of a vein, or orebody that has been cut with a bore-hole, without a survey to determine the position of the wedge. By referring to

wedge consists essentially of two parts; the anchoring device (1) and the wedge itself (2). The anchoring device is simply a hollow cylindrical piece of soft wood with a corrugated surface. The hollow space (3) is to accommodate the lower part of the wedge (4) when the wedge is first placed in the hole. The upper end of the anchor has a thread as shown at (5). The purpose of this thread is to engage the metal cap (6) that contains the metal dog (7); while the purpose of this dog is to engage the steeply-pitching spiral grooves (8) on the shank (4), thus effecting the rotation of the wedge (2)

when it is drawn up by the recovery wedge (18).

The grooves (8) on the shank (4) pitch steeply and are of uniform depth at all points except at such points as 9, 10, 11, and 12, which are at 90° from each other as shown in the sketch, and are for the purpose of effecting the release of the recovery wedge. It will be noticed that the inner rod is notched at the points 14, 15, 16, and 17. These notches are engaged by the dog (7) when the wedge (2) is rotated, because at points 9, 10, 11, and 12 the grooves (8) have holes cut in them to permit the dog (7) to extend deep enough.

When the dog (7) is engaging the notch (15), as shown, the wedge (2) is moving upward, the anchor (1) is stationary, and hence the inner rod (13) is pulled downward. When this happens, the catch (19) (see section *A A'*) is pushed downward to the position 19 *A* by means of the wedge (24), which exerts a pressure on the base of 19; 24 moves downward to the position 24 *A*, so that the dog (20), which is engaged in the notch (32) of the recovery wedge is permitted to move upward and disappear within the wedge (2), as shown at 20 *A*, thereby releasing the recovery wedge.

The dog (20) is mounted in a small and strong metal block (21) (see section *D D'*) which has a slot (22) sufficiently large to accommodate the dog (20) when it disappears as shown at 20 *A*. The disappearance of the dog (20) is effected as follows: when the catch (19) permits the block (21) to move upward in its slot (22) the dog disappears because of the pressure at the point 23 of the deflecting wedge.

As soon as the recovery wedge (18) is released, the block (21) is pushed downward by virtue of the pressure

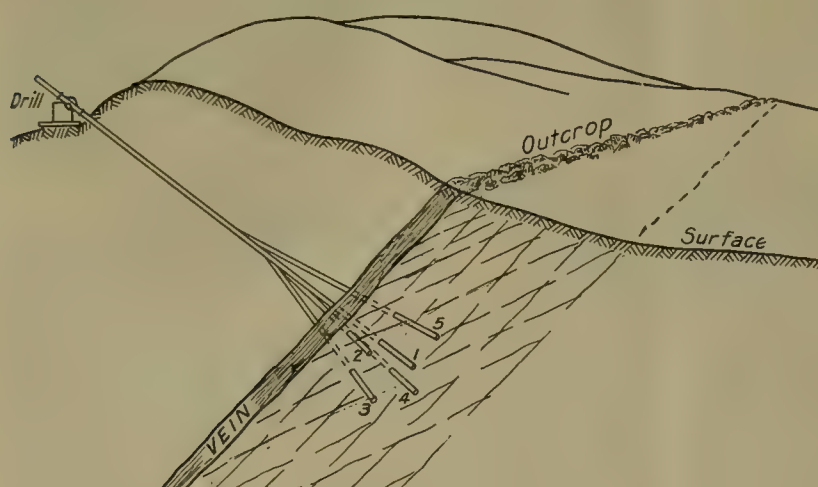


FIG. 1. STEREOGRAPH OF VEIN BEING DRILLED

the accompanying stereographic sketch, Fig. 1, the purpose of the device can be readily comprehended.

A deep bore-hole (1) has penetrated a vein. The sample recovered may be representative or it may not be. In order to obviate this uncertainty the deflector is placed in the hole, at random; the rods and bit are then reinserted and the first deflected hole (2) is drilled; the rods are withdrawn and the bit replaced by a recovery-tool which engages the wedge. The wedge is turned automatically through any desired angle (90° in this sketch), when the recovery wedge may be released, leaving the deflecting wedge in the new position. Drilling is again resumed, and this time the next hole (3) is drilled. This operation is repeated until the fifth hole is drilled, after which the recovery wedge is used to withdraw the multiple deflector from the hole. Nothing is lost but the wooden anchor, which is inexpensive. Thus we have five cores, accurately spaced, from which a reliable sample can be obtained.

DESCRIPTION OF THE MECHANISM. As shown in the accompanying sketch (Fig. 2) the multiple-deflecting

applied by the spring (25), and the dog (20) as soon as it passes point 23 again appears extended because of the pressure exerted by the spring (26); as soon as the dog (and, of course, also the block) is in this position, the catch (19) again returns to its normal position as shown in section $A-A'$. It will be noticed that at the bottom of the shank (4) of the deflecting wedge, there is a shoulder (27) which has a spring (28) pressing against it. This pushes the inner rod (13) so that its upper end (24) simultaneously assumes its normal position as do the dog and the catch.

In order to emphasize the positive and automatic action of this releasing arrangement, I wish to mention a few details. The dog (7) releases the same catch (19) instantly, but before the recovery wedge (18) has been released by the dog (20) the whole wedge (2) has moved upward the distance that (x in section $A-A'$) the block

wedge to rotate with the deflecting wedge (2) as it is being revolved into a new position and thus prevent the notch (32) from slipping off the dog (20). Also notice the threads (33) on the end of the recovery-wedge, that permit its being attached to the end of the rods when it replaces the bit of the diamond-drill.

When the wedge and anchor are lowered into the hole, it is evident that it will be necessary to have some means of holding them together. This is done by screwing a small metal strip along the side of the wedge and anchor. This metal should be barely strong enough to hold the two together so that no difficulty will be experienced in sheering it when the wedge is rotated.

Mention has been made of the fact that the anchor is made of soft wood with a corrugated surface. The purpose of the corrugations is to permit the cement to make the anchor more secure; the soft wood will also assist in

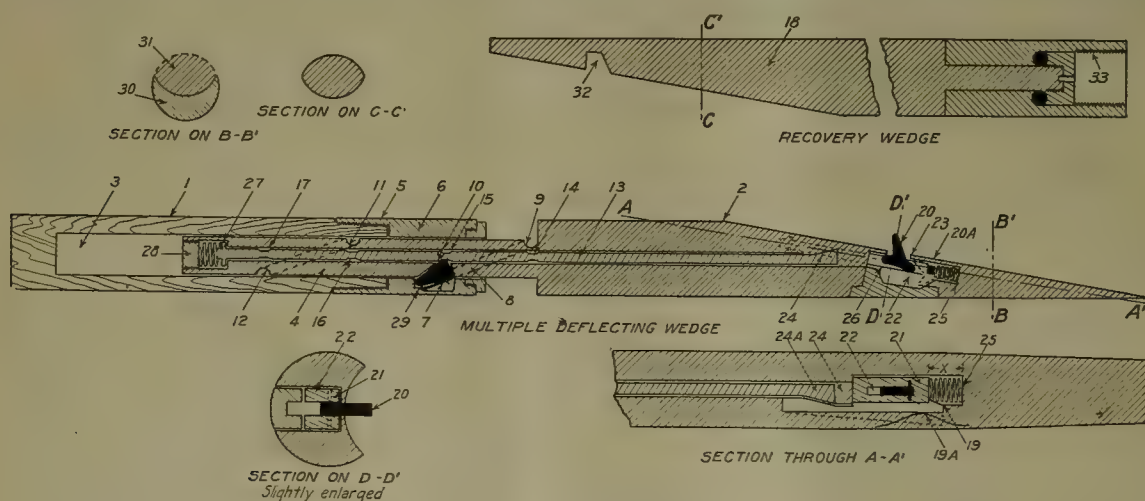


FIG. 2. DETAILS OF DEFLECTING AND RECOVERY WEDGES

(21) moves through before the dog (20) entirely disappears. This means that the other dog (7) no longer engages the notch (15), but is itself in its normal position, that is, engaging the groove (8). Another point is the manner in which the dog (7) prevents the wedge (2) from moving backward (downward) after it has once been pulled forward and rotated. The dog (7) is mounted by a pivot at point 29, which permits the dog to move out when the wedge is drawn upward, but, as soon as the wedge attempts to settle downward, the point of the wedge (7) digs into the bottom of the groove (8) and thus prevents it changing its position.

Referring to sections $B-B'$ and $C-C'$, it will be noticed that, when the recovery-wedge (18) is inserted in the hole, it is impossible for it to engage the dog (20), unless the wedge (18) is in the proper position so that it can pass along the face of the deflecting wedge (30), and assume the position as shown by the dotted line (31) after which the notch (32) will easily engage the dog (20).

Note the construction of the upper end of the recovery-wedge. The purpose of this construction is to permit the

this because it will swell when wetted. While the device has never yet been tried, it is mechanically plausible and I hope to make and use a wedge constructed according to this plan in some prospecting and development work that I expect to do within a few months.

The petroleum-refinery capacity of the United States is considerably overbuilt, according to figures of the Bureau of Mines. At present refineries have a total rated capacity over 50% in excess of the refinable oil supplies, which is likely to be near 80% when the refineries now under construction are completed. The oil-runs to the refineries of the United States for the year 1919 were 361,520,153 bbl. of crude oil, or 990,466 bbl. per day. In December 1919, the refineries in operation had a daily capacity of 1,356,355 bbl. per day, whereas, the daily run of crude oil to the stills was 1,046,052 bbl., indicating that they are running at only 73% of their rated capacity. Refineries of an additional 174,210 bbl. capacity per day were idle, while refineries totaling a capacity of 263,000 bbl. daily are reported to be under construction.

Federated American Engineering Societies

At a meeting attended by representatives of 67 national, state, regional, and local engineering and technical societies in Washington on June 3, the following resolution was adopted:

Resolved, That it is the sense of this conference that an organization be created to further the public welfare where technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions, and

Resolved, That it is the sense of the conference that the proper organization should be an organization of societies and affiliations and not of individuals.

The American Association of Engineers opposed the resolution during the discussion, but voted in the affirmative when it became apparent that the prevailing sentiment was strongly favorable. After protracted debate a constitution was agreed upon, 49 organizations casting their votes for adoption, the others being undecided as to their course. The constitution follows:

ART. I. NAME

THE NAME OF THIS ORGANIZATION SHALL BE FEDERATED AMERICAN ENGINEERING SOCIETIES

ART. II. OBJECT

Service to others is the expression of the highest motive to which men can respond, and duty to contribute to the public welfare demands the best efforts that men can put forth, therefore, it shall be the object of this organization to further the interests of the public through the use of technical knowledge and engineering experience, and to consider and act upon matters common to the engineering and allied technical professions.

ART. III. MEMBERSHIP

Sec. 1. *Scope*: The membership shall consist of national, local, state, or regional engineering and allied technical organizations and affiliations, classified as follows:

(1) National engineering and allied technical organizations.

(2) Local, state, or regional engineering or allied technical organizations other than local associations, sections, branches, or chapters of national organizations.

(3) Affiliations consisting of any one, or a combination, of the following constituents:

(a) Local sections or associations of members of national organizations included under (1).

(b) Local engineering or allied technical societies or clubs, not of national scope.

(c) Local engineers and members of allied technical professions and their associates.

Sec. 2. *Qualifications*: The qualifications for membership shall be as provided in the by-laws.

Sec. 3. *Application for Membership*: Application for membership shall be made in the form and manner prescribed in the by-laws.

Sec. 4. *Termination of Membership*: The membership of any constituent organization may be terminated by it or by the Council in the manner provided in the by-laws.

ART. IV. MANAGEMENT

AMERICAN ENGINEERING COUNCIL

Sec. 1. The management of this organization shall be vested in a body to be known as the 'American Engineering Council', and its executive board.

Sec. 2. *Functions*: The American Engineering Council shall consist of representatives of member-societies selected as hereinafter provided. This Council shall co-ordinate the activities of state councils and of local affiliations whenever these activities are of national or general importance or may affect the general interests of engineers.

Sec. 3. *Representation*: Each national, local, state, or regional organization or affiliation shall be entitled to one representative on the Council for a membership of from 100 to 1000 inclusive, and one additional representative for every additional 1000 members or major fraction thereof; provided that in the determination of the representation of local, state, or regional organizations or affiliations no count shall be taken of any organization which is represented individually or through another local, state, or regional organization or affiliation; and, provided further, that no organization shall have more than 20 representatives on the Council.

Sec. 4. *Selection of Representatives*: Representatives on the Council shall be selected as stipulated in the by-laws.

Sec. 5. *Meetings*: The Council shall hold an annual meeting. Other meetings may be called by the executive board and shall be called by it upon the written request of 25 representatives on the Council.

Sec. 6. *Officers*: The elected officers of the Council shall consist of a president, to hold office for two years, and who shall be ineligible to re-election, four vice-presidents, to hold office for two years, two to be elected every year, and a treasurer, to hold office for one year. These officers shall be elected by a letter ballot of the representatives on the Council as provided in the by-laws. There shall be an executive officer who shall also be secretary appointed by and holding office during the pleasure of the executive board. He shall not be a member of the executive board but may be a representative on the Council.

EXECUTIVE BOARD

Sec. 7. *Functions*: There shall be an executive board of 30 members of the Council constituted as hereinafter provided and charged with conducting the business of the organization under the direction of the Council.

Sec. 8. *Membership*: The executive board shall consist of thirty members, of whom six shall be the officers elected by the Council and twenty-four shall be selected, a part by the national societies, and the remainder by the local, state, or regional organizations or affiliations according to districts, as provided in the by-laws; provided, that the number of representatives of the national societies shall bear as nearly as may be the same ratio to the number of representatives of local, state, or regional organizations and affiliations as the representation of the national societies bears to the representation of the local, state, or regional organizations or affiliations.

Sec. 9. *Electoral Districts*: For the purpose of facilitating the selection of the district members on the execu-

tive board, the Council shall divide the country into districts as provided in the by-laws, based upon an equitable representation, having regard to both its membership and area.

Sec. 10. Officers: The president and secretary of the American Engineering Council shall be respectively the chairman, and the secretary of the executive board. There shall be two vice-chairmen elected by the board for its members.

ART. V. UNEXPIRED TERMS

Vacancies in the offices of the president, the vice-presidents, the treasurer, and in the executive board and among the representatives on the Council, shall be filled as soon as feasible, by the agencies originally selecting the incumbents. Officers and delegates thus chosen shall serve for the unexpired terms.

ART. VI. FUNDS

Sec. 1. Funds for the use of the organization shall be contributed as follows:

(a) Each national society represented on the American Engineering Council shall contribute annually one dollar and fifty cents (\$1.50) per member.

(b) Each local, state, or regional organization or affiliation represented on the Council shall contribute annually one dollar (\$1) per member.

No portion of such funds shall be applied to the use of local affiliations or state councils.

Sec. 2. The American Engineering Council may receive and administer gifts, bequests, or other contributions for carrying out the purposes of the organization.

ART. VII. LOCAL AFFILIATIONS

Sec. 1. Object: The American Engineering Council shall encourage the formation of local affiliations, to consider matters of local public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action and that suggestions and advice may be offered to the Council.

Sec. 2. Constitution: Each local affiliation desiring membership in this organization shall submit its constitution and by-laws and all subsequent amendments thereto to the executive board of the Council for approval of such portion thereof as may affect its eligibility, or its relation to the work of the Council.

ART. VIII. STATE COUNCILS

Sec. 1. Object: State councils, consisting of representatives of local affiliations within the state or otherwise representative of the majority of engineers and members of allied technical professions in the state, if members of this organization shall consider state matters of public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action in state affairs.

Sec. 2. Constitution: Each state council desiring membership in this organization shall submit its constitution and by-laws and all subsequent modifications thereto to the executive board of the Council for approval of such portion thereof as may affect its eligibility, or its relation to the work of the Council.

ART. IX. DELIMITATION OF AUTHORITY

Local societies, affiliations, state councils, and the American Engineering Council, shall deal with local, state, and national matters respectively, and they shall

be autonomous with respect thereto. It shall, however, be the duty of the American Engineering Council to interest itself in the activities of local affiliations and state councils if such activities are of national scope, or affect the general interest of the engineering and allied technical professions; provided, that nothing herein stated shall be construed as preventing the discussion by any local affiliation or state council or by the American Engineering Council of any matters of interest to engineers and members of allied technical professions, or action by the said Council on local or state matters where no local affiliation or state council exists.

ART. X. AMENDMENTS

Sec. 1. An amendment to this constitution may be proposed by the executive board.

Sec. 2. An amendment may be proposed in writing, by at least 25 representatives on the American Engineering Council; such amendment shall be considered first by the executive board, which may approve, disapprove, or formulate a modified or alternative amendment, report of which action shall accompany the original proposal to this organization.

Sec. 3. Any amendment proposed as provided in Sec. 1 and 2 shall be considered at a meeting of the American Engineering Council and shall be submitted to its members at least 90 days in advance of such meeting. At this meeting, provided a majority of the representatives are present, the amendment may be rejected, or ordered submitted to the members of the Council for letter ballot within 30 days thereafter, with such modifications as may be adopted by a majority of those present. The amendment shall fail of adoption if one-third of the votes cast are in the negative.

THE MOUNT MORGAN MINE produces practically all the gold from Queensland. The mine last year had an output of gold worth £381,351, besides copper to the value of £506,255. Development in this mine during the year consisted of 256 ft. of sinking, which was directed mostly toward facilitating the mining of the various sections. The quantity of ore raised and treated was 281,900 tons, and of this, 118,800 tons was sent directly to the smelters, the remainder (163,100 tons) passing through the concentrating plant. The total treated was 69,051 tons less than in the preceding year, the reduction, principally in concentrating ore, being attributable, not to any decreased capacity of the mine or plant, but to unusually long holidays at Easter and to a complete closing down for two or three weeks in June, owing to a strike of seamen on the Australian coast. The stopes are filled, mostly with concentrator tailing, as the ore is extracted. Another sintering unit has been completed, and as a consequence the rotary furnace and pot-sintering plants were discontinued after the Easter vacation. A flue-dust cooling and handling-plant has also been added to the equipment; the concentrating plant has been improved by the addition of two Dorr thickeners and two tube-mills, each of the latter requiring 80 horsepower, while two roasting-stalls, including flues, with the necessary crushing-plant, have been erected at the West Works. The company has extracted from the more shallow levels of the orebody some high-grade silicious gold ore, but the quantity of this ore is limited.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NORTH TIGRE LEASING CO. STARTS NEW MILL.

BISBEE.—The Boras Leasing Co., which has been operating for approximately three years, is now shipping 20 cars per month, averaging 7 to 8% copper. At a recent meeting a dividend of 10c. per share, payable June 20, was declared. It is understood that this is the first of regular monthly dividends of 10c. which the company expects to pay in the future. The Calumet & Arizona Mining Co. is engaged in sinking a ventilating shaft at its Briggs mine. This shaft connects with the 770-ft. level and will furnish a permanent outlet for smoke and gases from the large sulphide orebody, which has recently given some trouble.

It is said that the cost to Cochise county for the prosecution and acquittal of H. E. Wooton, first of 209 defendants in the Bisbee deportation cases, amounted to \$50,394. The trial of the 'blanket cases' has been postponed until fall.

The 50-ton mill, which has been in process of erection at the North Tigre Leasing Co., is now complete and in operation. The company expects to produce seven tons of concentrate daily, assaying not less than 350 oz. silver. More than 40,000 tons of silver ore, said to assay 35 oz., has been blocked out on the property. At the Flux property at Patagonia the new drift on the 260-ft. level that will explore the ground under the big carbonate ore-deposit has been driven 150 ft. through solid limestone to a point where further sulphide deposits should be penetrated. About four feet per shift is being made in the drift and the work will be pushed to thoroughly develop the 260-ft. level. Between 90 and 100 cars per month, averaging from \$20 to \$50 per ton, of silver-lead ore is being shipped by Tombstone lessees to the smelter at El Paso.

JEROME.—The United Verde Extension Mining Co. has declared the usual dividend of 50c. per share payable on August 1, to stockholders of record as of July 8. The Jerome Superior has decided to discontinue the use of oil-burning engines and electrify the plant throughout. This company has increased its directorate from five to nine members, one of the new directors being E. C. Joannes, head of the Joannes Tea Co. Work on the carbonate reef at the Dundee mine is said to be progressing steadily and satisfactorily. The process of treating this ore which has been developed at the Humboldt smelter is proving quite satisfactory and from 85 to 90% of the valuable metal is being recovered. It is understood

that a 100-ton plant is to be built immediately at Humboldt and that it is more than possible that a similar plant will be built on the Dundee.

CALIFORNIA

UNWATERING OF JACKSON MINES IS PROGRESSING SLOWLY.

AMADOR COUNTY.—But little headway is being made in unwatering the Kennedy and Argonaut mines near Jackson, both having been flooded to the Argonaut's



PROPERTY MAP OF JEROME DISTRICT

3500-ft. level last April in order to extinguish a fire which had been burning a year and was beyond control. To date all the hoisting of water has been done by the Argonaut alone. In the past five weeks the water-level has been lowered only 50 ft. Three air-lift pumps are ready for installation. The Kennedy company operates a steam-hoist, but so far it has been unable to secure

fuel-oil. The two mines are connected at different points down to the 4200-ft. level and to some it appears that the Kennedy people are using the situation as a club, considering the fact that the fire started in the Argonaut mine and finally reached the Kennedy workings. The latter company has levied assessment No. 6 of 15c. per share delinquent on June 21.

The work of unwatering the Fremont mine is progressing steadily. This property comprises the Fremont, Gover, North Gover, and Loyal lode claims, covering 4200 ft. on the Mother Lode. They have been worked through shafts on the Gover and the Fremont claims. Excessive costs due to war conditions caused the owners to discontinue mining low-grade ore about two years ago, since which time some of the surface machinery has been disposed of and the mine allowed to fill. Edwin Higgins is directing the work, and during the past two months the surface plant has been overhauled, electric motors and other modern machinery installed, and a good start made toward emptying the mine of water. In addition to better-grade ore that increased depth may reveal, a return to normal conditions as to labor and supply costs or government aid in the way of a gold bonus may assist the operation of the property. Alex Ross, formerly mine-foreman at the Kennedy, is superintendent.

Improvements to the surface-plant at the Central Eureka mine are under way. A new compressor, air-receiver, and boiler are now being installed; wooden mortar-blocks in the mill have been replaced with concrete, resulting in the successful handling of increased tonnage, and the shaft is now being sunk for a new level 150 ft. below 3700 ft., which is now the lowest point; 30 stamps of the 40-stamp mill have been operated steadily for many months, and probably additional stamps will be dropped when ore is obtainable from the new level. Sinking to the depth desired will be completed at present rate of progress by the middle of next month. After many years of assessment, stockholders have been receiving regular three-cent dividends since December 1919. Albion S. Howe is the superintendent of the mine, which adjoins the Old Eureka property on the south.

The shaft-contract for increasing the depth of the Old Eureka mine from 3050 to 3550 ft. was completed this week, after a long tedious struggle with heavy ground. The swelling ground caused the repeated crushing of 16 by 16-in. timbers. Four or five times timbers have had to be eased off; even the 18 by 18-in. material which was finally resorted to failed in many places to hold the ground. Similar difficulty was met in the previous sinking operations, but that part of the shaft appears now to have settled into satisfactory shape. A station will be cut and levels run to prospect the mine at this depth. Several promising veins have been cut during the course of re-opening this old mine, but the company appears to be devoting most of its energies toward attaining depth before attempting extensive lateral development. T. C. Gorrie is superintendent.

YREKA.—J. C. Hubbard, representing Seattle and Yakima, Washington, people, has been prospecting in

the Yreka district the past four years for gold properties. In 1919 he purchased the Spring Gulch property, then the Wacker mine, and later the Osgood, the Mono, and other adjoining mines and prospects, which now aggregate 500 acres. The Osgood is equipped with a five-stamp mill which is now working on the dump. He proposes to install a 50-ton Lane crusher to operate on the 30,000-ton dump on the Osgood, which averages \$7 per ton of free gold. These several properties have been operating the past 30 years and have produced in a crude way over \$100,000. The whole property has been carefully surveyed and platted by the new owners, who plan to operate the mines systematically.

COLORADO

EXPLORATION TUNNELS BEING DRIVEN AT ASPEN.

ASPEN.—The Park tunnel has been driven 2300 ft. with 800 ft. remaining for the projected connection with the Last Dollar incline, sunk on the Justice fault, in the Tourtelotte Park section. The heading is now in quartzite, believed to be intrusive. The Hope tunnel is following the Hope fault and it is expected that ground favorable to the deposition of ore will shortly be entered. The contact has been the chief source of ore nearer Aspen. The lime now contains some silver. Both tunnels are operated by the Hope M. M. & L. Co. In the Jenny Lind tunnel a raise is going up in what is believed to be the Silver contact between Blue lime and Weber shale. The ore broken is being saved for shipment. The shoot at the tunnel level is 70 ft. long.

BRECKENRIDGE.—Operations have been resumed in the Sunnyside tunnel entering Gold hill, in the 10-Mile Consolidated district, by E. D. Burke of Cripple Creek. A lead-carbonate ore assaying as high as \$110 per ton is being mined from a four-inch streak and the remaining matter in the four-foot vein averages \$27 per ton. The ore contains 26% lead and as high as 32 oz. silver and some gold.

Stilwell Connor operating the Pearl property, in the Robinson district, is mining a good grade of silver ore through a tunnel. He will soon start shipments to the A. V. smelter at Leadville. The Pearl is controlled by the estate of the late C. J. Moore.

SILVERTON.—The Queen City property in Ohio gulch in the Gladstone district, a former shipper of high-grade silver-lead ore, has been leased after years of inactivity and is in operation. The United States Mines Corporation owning the Copper Belle in Whitehead gulch has let a contract for extending its tunnel to local miners. The object is to cross-cut the Copper Belle vein that produced rich ore in workings nearer surface. The Gold King Extension mill is running steadily and from one to three cars of concentrate is shipped to the smelter daily.

GEORGETOWN.—Roads are rapidly being re-opened and mining activity is increasing accordingly. Supplies have been sent up to the Waldorf, where work has been resumed and the Jeffery property, in Grizzly gulch, is again active. At the Denbigh men are repairing the pipe-line

and water-power will be substituted for steam. The working force will be increased when power is available.

The new tramway at the St. George started operating this week and ore is now moving. A compressor and other equipment is being installed in preparation for rapid development during the summer season. A consignment of two to three-ounce gold ore was shipped last week from the Ramsdell mine on Lincoln mountain, by the owner, John A. Heim of Empire.

MAYDAY.—Milton Deluche, operating the Esmeralda, situated on the south fork of Lightner creek, is mining ore from a vertical line contact; it assays 19 oz. silver per ton. Tom Welborn and Joe Clark, lessees on the Idaho dump, are shipping ore said to assay $2\frac{1}{2}$ oz. gold per ton. Fred Brandiger is loading a car of high-grade

Physically the mine is in prime condition. There is no difficulty except the shortage of miners. Baltic produced 15,000 tons last month. In April Baltic produced 17,400 and a year ago was producing 20,000 tons monthly. Tri-mountain produced in May, this year, 8900 tons of rock, compared with 11,700 in April and 16,000 a year ago. These mines are having the additional problem of a continual drain of employees to the manufacturing centres and the local farms.

Seneca's total output in May was 5611 tons which averaged over 30 lb. In April Seneca produced 3569 tons. Seneca's production for June will be well over 7000 tons if the present rate is maintained.

The one large piece of construction work to be undertaken in the Lake Superior district this year is the re-



THE KENNEDY MINE, AMADOR COUNTY, CALIFORNIA

ore from his lease on the Idaho. The Jumbo Mining Co. is shipping from a lease on the Jumbo. Henry Houser has started work at his property west of the La Plata. The cross-cut at the Little La Plata, which is in 170 ft., is being pushed, but as yet no vein has been found.

MICHIGAN

RE-TREATING PLANT FOR TAMARACK SANDS.

HOUGHTON.—While the copper content is higher than at any time in recent years, and while the amount of mass and barrel copper is larger than it has been for a long period, the production of copper 'rock' from the three mines of the Copper Range company, the Champion, Tri-mountain, and Baltic, has reached the lowest point in recent years. Champion, the richest mine in the district, now turning out a grade of rock which is averaging 45 lb. to the ton, produced 22,000 tons last month. A year ago Champion was mining 38,000 and 40,000 tons per month. In April, this year, Champion produced 25,400 tons.

treating plant to be built for the Tamarack sands on the shores of Torch lake. This work will be undertaken by the Calumet & Hecla corporation. It will involve an expenditure of at least two millions of dollars. The purpose of the plant will be to treat the old Tamarack conglomerate sands. The plant will be an exact duplicate of the Calumet & Hecla plant at Lake Linden where the Calumet conglomerate sand now is being treated. This Lake Linden treater demonstrated the metallurgical practicability of working this old tailing. Today this mill is the one surely profitable operating 'mine' in the copper district. Its costs are down to six cents. Little labor is required. The assays are true to form in the returns secured. There is at least 50,000,000 tons of sand still in the lake to be treated. Calumet & Hecla purchased the Tamarack outright seven years ago, shortly after the attempt of the Calumet & Hecla interests to consolidate many of the copper-producing corporations in which the older company had a stock interest. The Tamarack mine originally was established because Michigan mining laws

recognize lateral boundaries, not the apex rule. The Tamarack bought property on the lateral extension of the Calumet conglomerate lode, and went down through dead ground for a mile before encountering the formation. It operated independently for 30 years, with varying success. The milling results were about the same as the results of the Calumet & Hecla and the tailing losses were large; the material piling up on the lake shore totaled 30,000,000 tons. Complete assays have been made and the tests have been on a line with those made of the same lode on the Calumet property. The result is the determination to treat this sand by exactly the same method now in use on the Calumet sand.

The coal situation is becoming more and more embarrassing for the copper mines. Some properties will be compelled to suspend operations within 30 days unless there is a change. Calumet & Hecla interests have enough to run 60 days but no longer. The copper mines are in a quandary as to the future. According to present figures their coal will cost them \$12 per ton, delivered, if they make contracts at present prices. Such prices are prohibitive for every mine in the district unless copper sells at 30c. instead of at 20. The coal bill for the copper mines of Michigan will be higher than \$14,000,000 at the present price. Copper Range mines bought some coal from the recently suspended Winona and picked up some from the Beacon Hill, enough for a couple of weeks. They considered themselves fortunate to get it. Mohawk is experimenting with steel scrapers using four of them successfully in flat stopes where gravity helps out the trammers. Mohawk is securing more mass than ever before in its history from the regular vein material, not from the fissure vein.

MONTANA

NEW DISCOVERY BY BUTTE-JARDINE COMPANY.

HELENA.—The Vera Cruz company has uncovered a rich silver vein on its 150-ft. level. M. J. McEvans reports a promising outlook for the property.

NEIHART.—Development at the Moulton, when the mine is re-opened, will be confined to thorough lateral exploration by the extension of levels. This development work will continue for several months or until the extent of the orebody is determined. The shaft is down 600 ft. A winze has been sunk 100 ft. below the 600-ft. level. The mill before the close-down was operating on an old dump and on ore from lessees. Drifting on the 300-ft. level of the Hartley mine has reached points 40 ft. to the north and 50 ft. to the south. Samples from these drifts assay 80 to 100 oz. silver per ton. The north drift on the 200-ft. level also shows considerable ore of a high grade.

SALTESE.—Work has been resumed at the Lawrence mine with a crew of 12 men. A wagon-road has been opened to the property. A 200-ft. tunnel is being driven west to open up the orebodies. H. M. Lancaster is engineer in charge.

DEER LODGE.—The Butte-Jardine Mining & Milling Co. reports a find of rich silver ore on the 600-ft. level of

its Champion mine. The ore assays more than 600 oz. silver and nearly 2 oz. gold per ton. Further work shows ore to come from a vein and not from a pocket. The ore will be hauled by team a distance of six miles, where it will be loaded for shipment to the smelter. Fifteen men are employed at the property.

NEVADA

ROUND MOUNTAIN COMPANY WILL MAKE GOOD PROFIT FROM PLACER OPERATIONS.

ROUND MOUNTAIN.—It is predicted that the final clean-up of the sluices of the Round Mountain Mining Co. will show the best results in the history of the company. It is expected that not less than 100,000 yards of gravel of an average value of \$1 per yard will be washed during the present season, as indications are that there will be ample water to continue work until late in September. The placer field is estimated to contain 2,000,000 yards of gravel averaging \$1, the bed-rock in places being at a depth of 75 ft. Two giants use water held by dams in Jett and Shoshone canyons. The placer was deposited by the erosion of the quartz veins of Round mountain and the field extends around the mountain and westward into Smoky valley.

RAILROAD SPRINGS.—The Silver Coin Mining Co., owning nine claims four miles west of the Allied, has been financed in San Francisco and the East and work will be started on July 1. A small hoist and pump have been bought. The first work will be in extending drifts from a 75-ft. shaft in which ore from 6 in. to 3 ft. wide gives high assays in silver.

GOLD MOUNTAIN.—The tunnel of the Washington Gold Quartz will reach the objective, a point under a 20-ft. shaft, in an additional 40 ft. Good ore was found in this shaft and the tunnel will cut the vein at a depth of 140 ft. The company is well financed and if ore is found it is planned to do a large amount of work.

MONTEZUMA.—The shaft of the Montezuma Silver Mines Corporation is 375 ft. deep and sinking is being continued. The finding of rich ore by this company several months ago at a depth of 250 ft. caused a rush into the district, but the ore was in a small lense and little work was necessary to prove the find of no value. Sinking was then resumed and this has resulted only in the opening of unimportant seams of rich ore.

DIVIDE.—The Belcher company is to be reorganized on an assessable basis. A statement issued in announcing the reorganization gives the cash in the treasury on June 1 as \$3172. The operating expenses from January 1, 1919, to June 1, 1920, were \$44,545, of which \$25,560 was for labor and \$18,985 was for supplies. The cost of shaft-sinking is given as \$39.61 per foot and of drifting, \$12.31.

GOLDFIELD.—The Grandma continues cross-cutting from a winze from the 815-ft. level and low assays are being secured. If ore is not found by July 1 preparations will be started to resume sinking the shaft. A 100-ft. drift is now used as a sump and when sinking is resumed water from below the 815-ft. level will be raised to this

sump and lifted to the surface by a pump on the level. The Great Bend has driven 65 of a necessary 100 ft. to drift around bad ground on the 375-ft. level and when the work is completed drifting from a raise from this level will be continued. A lease has been let west of the shaft, where the company has done no work except on the 400-ft. level. The lessees are prospecting on the surface for an ore-shoot and if they succeed in finding one the company shaft will be used in further work. Lessees on the 650-ft. level of the Jumbo Extension have shipped a carload of ore from which returns have not been received. They are now cross-cutting north-west from the main shaft to cut the downward extension of a shoot from which ore was shipped several years ago. It was the stopping of ore in this territory north-west of the main shaft

erected it will give a total of 18 stamps of different types and weights.

PIOCHE.—The shaft of the Prince Consolidated is 640 ft. deep and it is being sunk three feet daily. At the 600-ft. point a cross-cut has been started to a 'gold' vein 200 ft. distant. The next lateral work will be at about 800 ft., where the diamond-drill cut 10 ft. of ore assaying 30 oz. silver and \$4 in gold. Nearly 7000 tons of ore was shipped last year from the upper levels. The object of deepening the shaft is the exploration of beds of quartzite under the lime-shale from which the early production was made. Nearly 1,000,000 tons of ore has been taken from the upper formation.

VIRGINIA CITY.—The all-steel New Zealand-type dredge of the Gold Canyon Dredging Co. has been launched in



THE BADGER STATE MINE OF THE ANACONDA COMPANY AT BUTTE

and near the line of the Clermont mine of the Consolidated that led to the Booth apex suit. The Development has started the mill, using 10 stamps. The first ore is coming from the Red Top mine of the company. The tunnel of the Five to One, in the far southern part of the district, is over 400 ft. long. Richer pannings than at any previous point are being secured, but there is no indication that the tunnel will cut a vein.

TULE CANYON.—The shaft of the Silver Hills, operating the Ingalls under option, is 45 ft. below the 100-ft. level, where sinking was started by the Silver Hills. The shaft is now in soft lime and there is exposed in it a three-foot width of ore assaying 120 oz. silver and \$20 in gold. The present depth has been reached with hand-drills, but a compressor is being put in place. The five-stamp mill is treating ore from above the 100-ft. level and additional stamps are being purchased. The mill equipment is being bought second-hand at a number of places and when it is

the Gold Creek placer field, near Silver City. The dredge dumps buckets of nine cubic feet at a rate of 20 per minute. It weighs 900 tons and is 108 ft. long and 52 ft. wide. The dredge is single-lift with stacker and it will work to a depth of 40 ft. The sand is delivered to a trommel and the fine goes over tables of a total area of 3000 sq. ft. Electric power will be furnished by the Truckee General Electric Co. and the water will come from the pipe-line of the Virginia and Gold Hill Water Co. The field as prospected contains 200 acres. The Gold Canyon Dredging Co. is one of several companies promoted by Bulkeley Wells for operations in the Virginia City district.

MINA.—Commercial ore has been found in cross-cut 701 on the seventh level, 150 ft. below the sixth level of the Simon Silver-Lead property. This is the first verification of the belief expressed by Walter Harvey Weed, in his report on the property dated December 5, 1919,

that orebodies developed on the sixth level would be found to extend deeper. Pumps on the seventh level are handling the increased flow of water without difficulty. The cross-cut on the sixth level beyond the west fault is following a high-grade streak of silver ore.

High-grade ore has been found in the south-west cross-cut on the 350-ft. level of the Simon Contact property. A cross-cut is being driven to cut the Mammoth vein that enters the Contact property from the Simon Silver-Lead ground, adjoining on the south. It has already been opened on the surface by trenches for a distance of 450 ft. The cross-cut being driven from the 100-ft. level of the Fagan Consolidated property to cut the fissure 60 ft. west of the shaft has entered mineralized ground after passing through 42 ft. of barren limestone. The shaft is being sunk an additional 200 ft. Nineteen sacks of high-grade silver ore were shipped by express from the C and A property to the Selby smelter. The shipment was insured for \$1 per pound. Assays from various sacks range from 920 to 9448 oz. per ton.

UTAH

WORK ON NEW UTAH CONSOLIDATED CONCENTRATOR TO START.

BINGHAM.—Construction of a flotation-plant at an approximate cost of \$500,000 with a capacity of 1000 tons per day for the purpose of handling the low-grade ores of the Highland Boy mine, will begin immediately. Officials of the Utah Consolidated company and of the General Engineering Co. visited the site near the International smelter at Tooele where they say an ample water-supply for the plant is available. The ore will be transported from the mine at Bingham to the new mill, a distance of four miles, by the overhead tramway which is in use at the present time for handling straight-smelting lead and copper ores. Last year the company leased a small mill and began a series of exhaustive tests. Recent development work in the mine is opening up copper mill-ore on the lowest levels in the Highland Boy and Yampa limestones.

Development work of an important nature is being pushed at the Montana-Bingham mine, according to Thomas E. Billings, consulting engineer. While shipments are being maintained at a normal rate, sinking, raising, and drifting are being carried on in the Mayflower vein. The company is building a spur-track and ore-bins to facilitate the shipment of ore. The development work in the Mayflower vein has as its objective the opening of rich shoots of ore found in the Montana-Bingham level. The average of the shipments from these shoots during the past year had been 6 to 16% copper, 2 to 6 oz. silver, and from \$1.50 to \$4 in gold. In addition, the ore carries an excess of iron, which reduces the cost of smelting to a minimum. Sinking upon this vein has progressed 215 ft. below the Montana-Bingham level. A shipment from the 150-ft. sub-level recently made averaged 12% copper and 4 oz. silver per ton. Development of these shoots indicates that the enrichment is increasing as greater depth is attained.

EUREKA.—The directors of the Tintic Standard Mining Co. have declared a quarterly dividend of 10c. per share, aggregating \$117,470, payable July 20. This will bring the total dividend disbursements up to \$1,186,192. The ore-reserves in the mine are being increased and the property is in excellent shape. The main working shaft is at a depth of 1450 ft., and there is a large amount of good ore on that level, although no effort is being made to draw ore from that depth. Drifts are being sent into the ore for the purpose of determining the size and value of the deposit.

Because of the surplus of ore at its plants, the American Smelting & Refining Co. placed a temporary embargo against the shipment of ore from some of the Tintic mines. Iron ore, however, was accepted at full production. The embargo was lifted on June 20. The Eagle & Blue Bell and the Victoria were the hardest hit by this embargo, practically all of the product from those mines being sold to the A. S. & R. Co. Some of the other large shippers have contracts with the United States and International Smelting companies and were not seriously affected by the embargo. A total of 143 cars was shipped during the week ending June 12, of which the Chief Consolidated shipped 40; Tintic Standard, 20; Iron Blossom, 17; Dragon, 17; Grand Central, 8; Gemini, 7; Iron King, 6; Centennial-Eureka, 6; Eagle & Blue Bell, 4; Colorado, 3; Empire, 3; Victoria, 2; Godiva, 2; Seranton, 2; Cornucopia, 2; Mammoth, 2; Primrose, 1; Sunbeam, 1.

After several months of development work the Tintic Paymaster Mines Co., in the North Tintic district, has been rewarded by the disclosure of the first shipping ore opened at any considerable depth. On the 400-ft. level in the north drift, which was started from the main east drift when it cut a fissure about 400 ft. from the bottom of the shaft, a stringer of ore, varying from 8 to 18 inches in width and averaging \$7.65 in gold and 16 ounces of silver per ton, was found. H. G. Snyder, manager, also states that the east drift, now in 850 ft., is showing an important change in formation, indicating the nearness of one of the large objective fissures.

Leasing operations at the Centennial-Eureka mine are active. Recently a shipment made by Irwin Spriggs netted between \$4000 and \$5000 for one carload. At the Iron Blossom mine, sixty lessees are working. One shipment, taken from what is known as the Jackson-Swensen lease, averaged 180 oz. silver per ton, while shipments from this same mine, by other lessees, are averaging from 100 to 114 oz. silver per ton.

John Enlund superintendent of the local properties of the United States Smelting Co., states that the work of re-timbering the Bullion Beck shaft is going along quite rapidly. It is expected this work will be completed by July 5, when hoisting operations will be resumed. Since the shaft work was started, the lessees in the Bullion Beck have been using the workings of the Gemini and Centennial Eureka in going to and from work, while the ore has been stored in underground workings.

PARK CITY.—The Judge Mining & Smelting Co. has posted dividend No. 37, being the regular quarterly dis-

bursement of 12½c. per share. This will total \$60,000 and will be paid on July 1. The grand total of dividend disbursements to date by this company is \$3,380,000. The electrolytic smelter of the Judge company is operating in a satisfactory way, according to G. W. Lambourne, general manager. One-half of the plant is producing its rated capacity of seven tons of zinc cathodes per day. Physical conditions in the mine are most promising.

The Naildriver mine is looking better than ever in its history, according to company officials. In the cross-cut on the 700-ft. level, there is three feet of good ore in the face; on the 600-ft. level the entire face is in ore; and on the 900-ft. level, there is from two to four feet of ore.

Labor is becoming more plentiful, and with continually improving conditions in the King Coalition, the Ontario, the Keystone, the Naildriver, and the Park-Utah mines, the outlook in the district is brighter than at any time in years. Shipments for the week ending June 12 totalled 2004 tons, as against 1817 tons for the preceding week. The Judge M. & S. shipped 812 tons of ore and the smelter 35 tons of spelter; the Ontario, 504 tons; the Silver King Coalition, 441 tons, and the Daly-West, 224 tons.

The directors of the Daly Mining Co. have declared a dividend of 10c. per share, payable July 2. This is the ninety-third dividend to be paid by this company, and it will call for a total of \$15,000. The company is controlled by Col. E. A. Wall, who recently gave an option on all of his holdings to Geo. W. Lambourne of the Daly-West company, at a price of approximately \$3 per share.

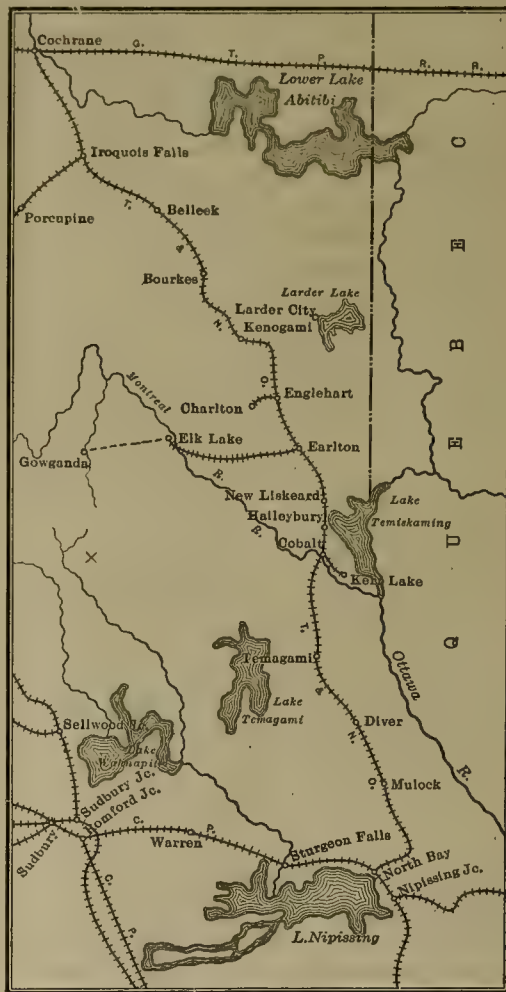
ALTA.—With the Little Cottonwood railroad opened to its terminus, mining men are looking forward to the most productive season in years. Shipments are now being made down the three canyons steadily. The largest shippers this season will be the Cardiff, the Sells, the South Hecla, the Columbus Rexall, the Emma Silver, the Michigan-Utah, the Alta Consolidated, and the Louise. The South Hecla mine, according to George H. Watson, general manager, during the past month has opened a rich stope in the east side of the property, known as the 'Rustler'. The carbonate stope, which has been placed in readiness for production on the 600-ft. level on the west side of the mine, shows a better grade of direct smelting ore than on any of the levels above. These stopes are almost 4000 ft. apart, showing that the mineralization in the property is persistent. There are excellent prospects of other stopes being opened between those now ready for production.

BRITISH COLUMBIA

DOLLY VARDEN RAILWAY IS OPERATING.

ALICE ARM.—The Alice Arm-Dolly Varden railway is in operation and the mine is making regular shipments to Anyox, once again. The work of erecting new ore-bunkers is well under way, and soon they will be in use and will considerably facilitate shipping. The railway is being re-railed with 50-lb. rails in place of the 35-lb. rails that originally were laid. There has been a big influx of people to Alice Arm, many of whom are living in tents, as

there is no other accommodation. Three hotels are in course of construction. The Golsheish mine, at Silvester bay has made a number of small shipments to Anyox, recently. The vein has an average width of six feet, and has been uncovered on the surface over a length of nearly 3000 ft. The ore runs high in both gold and silver, some samples assaying upward of \$3000 per ton, and it is in demand at the smelter for fluxing purposes. A wharf is being built and a tunnel is being driven to cut the vein



MAP OF NORTHERN ONTARIO

at a lower level. When this is completed the ore will be trammed from the tunnel directly to the wharf and shipped in scows to Anyox, three miles away. A three-drill compressor is being erected at the property. Work has been started at the Patricia group, four miles up the south fork of the Marmot river. A four-foot vein assaying \$15 to \$35 in gold and 50 to 60 oz. in silver is being developed.

TRAIL.—After giving it a thorough test, lasting over several months, the Consolidated M. & S. Co. has decided to abandon the idea of a wet magnetic concentration in favor of flotation for its Sullivan mine ore. The ex-

perimental plant failed, of course, to remove the pyrite of which at times there is a considerable amount. The plant is being dismantled and another flotation plant will be erected in its place and on the same site. It is expected that the company will blow-in one of the copper blast-furnaces and start part of the converter plant and part of the copper refinery about the beginning of July. The other blast-furnaces will be put in operation as the needs demand, which will depend largely on when the Canada Copper Corporation starts to produce concentrate. It is expected, too, that shipping of high-grade ore will be resumed shortly from the company's Rossland mines. It is unlikely that any quantity of low-grade ore will be shipped until the concentrating plant, which is being erected to treat this ore at Trail, is completed. Only development work has been done at the Rossland mines for several months, and the miners will welcome the starting of mining operations again.

GREENWOOD.—Duncan McIntosh, one of the lessees of the Bell mine, reports that the mine work is continuing as actively as the shortage of labor will permit. However, the men available are working in ore averaging 175 oz. silver, 8% lead, and about 8% zinc. Nearly 1100 ft. of driving and cross-cutting has been done and several good veins are exposed, three of which are being worked.

QUESNEL.—The operations of S. J. Marsh, of the Cariboo Gold Platinum Extracting Co., are being watched with interest by the miners of the Cariboo, as well as by those interested in placer ground throughout the Province. Mr. Marsh announces that he is in the market for black sand such as is found along the Fraser, Tulameen, Thompson, and other rivers of British Columbia. This contains some gold and platinum and it is Mr. Marsh's claim that he has invented, and demonstrated in a practical way, a device for the economic extraction of these precious metals from the sand. The plant necessary for his 'electro-chemical process', as it is termed, is reported to have been assembled at Quesnel. Mr. Marsh, in his request for black sand of the character indicated, undertakes to guarantee a recovery of 90% of the assay value of the same. In order to assure the continuous operation of the Quesnel plant he is installing on the Quesnel river, some 28 miles above the town, a drag-seine dredge equipped with a concentrating device designed to separate the black sand from the gravel.

ONTARIO

PRODUCTION OF COBALT HELPS SILVER-MINING COMPANIES.

COBALT.—During the first quarter of 1920, the mines of Ontario produced \$2,954,695 worth of silver, as compared with \$3,152,700 during the corresponding period of 1919. This decline of \$198,005 was more than offset, however, by an increase of \$233,000 in the value of cobalt and cobalt oxide produced as a by-product from the silver mines. Inclusive of the by-product, the value of the output for the first quarter of 1920 amounted to \$3,404,774, as compared with \$3,369,452 for the corresponding period of 1919.

During May the Nipissing mine produced \$335,597,

making a total of \$1,837,118 for the first five months of the current year. The low-grade mill treated 7138 tons and the high-grade plant 196 tons of ore. Several new veins, very narrow but of comparatively high grade, were opened during the month.

Arrangements are being made to re-open the Colonial mine. This property has been idle for a number of years. It is situated adjacent to the O'Brien mine as well as the Violet property of the La Rose Consolidated. It is in the hands of strong American financial interests who are fully conscious of the fact that the property has potentialities and who refused repeated offers for its purchase. Underground work is now being laid out.

PORCUPINE.—The Davidson is arranging for operations on a largely increased scale. The workings are now at a depth of 600 ft. with a good tonnage of ore opened at various levels. Sections of the drift on the 500-ft. level are stated to show an average gold content of \$49.20 over a considerable distance. Diamond-drilling is being carried on to explore the vein at a depth of 1500 ft. and a new four-compartment shaft will be sunk to the 1000-ft. level. The Keora-Porcupine has struck a new vein of good ore eight feet wide in sinking its new shaft at a depth of 160 ft. The Hudson Bay Mines has discontinued operations at the Dome Lake and the mine is now flooded with water.

KIRKLAND LAKE.—The opening of the Tough-Oakes mine has been considerably delayed and no underground work has yet been undertaken. The mill is being repaired and will shortly be in good condition. The Kalgoolie-Kirkland Gold Mines, Ltd., organized in December last, has gone into liquidation.

BOSTON CREEK.—This camp narrowly escaped destruction last week from the bush fires which ravaged large areas in Northern Ontario. It was entirely cut off from communication with the outside and the citizens fought the flames for three days before the danger was over. Work at the Miller Independence has been speeded up since the installation of electric equipment. At the 500-ft. level the cross-cut, which is being run to cut the vein, is now 200 ft. from the shaft, and is passing stringers carrying sulphides, indicating the proximity of the vein.

GOWGANDA.—Activity in this field is being stimulated by the prospect of the improvement of transportation conditions by the building of the railway from Elk Lake. The operating companies have not been handicapped by labor shortage so badly as in other mining districts. The shaft on the Castle property of the Trethewey is down over 150 ft., at which depth the vein shows a width of six inches of high-grade ore in addition to several feet of milling material. Thirty tons of high-grade is ready for shipment. On the Bonsall, adjoining the Castle, high-grade ore has been found at the 100-ft. level. The Reeves-Dobie is preparing to begin operations, and a number of small properties will be worked on a larger scale as soon as the high cost of supplies and material is reduced by the construction of the railway. The Big Four mining plant was completely destroyed by a forest-fire and other properties were in considerable danger.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Welton J. Crook is in Seattle.

W. W. Mein is at Lake Tahoe.

George B. Terrell is at Long Lake, New York.

H. H. Palmer, of Boise, Idaho, is in San Francisco.

W. T. Jones, of Ranger, Texas, is at Salt Lake City.

Morton Webber has returned from Idaho to New York.

J. Burns Read, of Urbana, Illinois, is at Golden, Colorado.

Jeffrey Schweitzer, of Tonopah, Nevada, is in San Francisco.

James Martin, of Yucca, Arizona, is at San Diego, California.

H. H. Schlapp is expected shortly in San Francisco from Melbourne.

Albert Turner has gone from Oatman, Arizona, to London, England.

Herbert A. Wilcox, of Pasadena, California, has moved to Aspen, Colorado.

Fernando Montijo Jr., of Arizpe, Mexico, is at Berkeley for a short time.

E. A. Strong, formerly of Ocotello, Arizona, is at Mokelumne Hill, California.

E. P. Mathewson, of New York, made a brief visit to the Globe district recently.

T. A. Rickard gave an address before the Los Angeles section of the Institute on June 25.

Thomas H. Teal is manager for the Liberty Mining & Reduction Co., at Montezuma, Colorado.

R. H. Channing, president of the Utah Con. Mining Co. at Bingham, Utah, is at Salt Lake City.

W. L. Kerr, of Denver, is at Los Angeles, on his way to examine a mine in southern California.

W. W. Copp, of Nelson, Nevada, is now with the United Eastern Mining Co., at Oatman, Arizona.

Horace G. Nichols is general mine-superintendent for the Mazapil Copper Co., in Zacatecas, Mexico.

A. C. Ensign has been appointed assistant superintendent of the Arthur plant for the Utah Copper Co.

Richard M. Geppert, of Minneapolis, is on his way to make an examination of mines in British Columbia.

John Kiddie, division-superintendent of the Arizona Copper Co., is spending a few weeks in California.

H. C. Goodrich, chief engineer for the Utah Copper Co., was at Los Angeles and San Francisco recently.

J. N. Hauser, general manager for the Tennessee Copper Co., is making a trip to Western mining camps.

Morris P. Kirk has resigned as general manager for the Yellow Pine Mining Co., at Good Springs, Nevada.

Sidney J. Kidder, general manager for the Mogollon Mines Co., New Mexico, was a recent visitor to the Clifton-Morenci district.

J. M. Hill is the geologist assigned to the San Francisco office of the Geological Survey. He will begin work here on August 1.

Frank P. Knight, president of the Iron Cap Copper Co., who has been spending the winter at Globe, has returned to his home at Boston.

Paul Lord, formerly general foreman of the Morenci branch of the Phelps Dodge Corporation, has been promoted to mine-superintendent.

E. W. Engelmann, research engineer for the Jackling porphyry properties, is making an inspection of the Ray and Chino concentrating plants.

George H. Garrey, consulting geologist for the Tonopah

Belmont Development Co., has just returned from a trip to Surf Inlet, British Columbia.

George P. James, formerly mine foreman with the South American Development Co., at Ecuador, is now with the Guggenheim Brothers, at La Paz, Bolivia.

Charles F. Sturtevant, mining engineer of Salt Lake City, has returned from Bolivia, where he examined the Empresa Trinacria property for New York capitalists.

C. H. Benedict, chief metallurgist for the Calumet & Hecla company, is in attendance at the National Convention of the Democrats as one of the delegates from Michigan.

R. O. Dobbs, manager for the Louise Mining Co. at Alta, Utah, is making an examination of the Silver Slipper mine in the Silver district, 18 miles north of Wendover, Utah.

George Kingdon, general manager for the United Verde Extension Mining Co., and Dave Morgan, manager for the Verde Combination Copper Co., sailed for Europe recently.

I. Cummings, for many years smelter-foreman for the Cananea Con. Copper Co., has gone to Venezuela where he will enter the services of a South American copper company.

Ernest Gayford, of the General Engineering Co., Salt Lake City, has been making an inspection of the property of the Stargo Mines Co., preliminary to the construction of a mill.

John Linn, mine superintendent for the Empire Copper Co., has resigned. He has been succeeded by L. D. Abels, formerly of the Santa Gertrudis and Peñoles mines in Mexico.

James Colquhoun, for many years general manager for the Arizona Copper Co., has been spending several weeks in the Clifton-Morenci district with his son Capt. Clifton Colquhoun.

John C. Greenway, general manager for the Calumet & Arizona and New Cornelia Copper companies, recently made the trip from Ajo to Tucson, a distance of 115 miles, by aeroplane in one hour and fifteen minutes.

T. H. Jenks, of Los Angeles, who has been spending some time in New York and Boston, is now on his way to Denver and will be engaged upon professional work in Colorado most of the summer with headquarters at Lake City.

Frank Pelton, mine-superintendent of the Tyrone branch of the Phelps Dodge Corporation, has resigned and expects to engage in business in New York. Donald Miller, formerly assistant superintendent, has been appointed mine-superintendent.

Obituary

Whitfield P. Pressinger, vice-president of the Chicago Pneumatic Tool Co., died in New York on June 10 as a result of complications following an operation. He was actively engaged in the pneumatic tool and allied machinery industry for many years. He was general manager for the Clayton Air Compressor Co. for seven years and became widely known through activities in the American Society of Mechanical Engineers and the Compressed Air Society. He was born in New York City in 1871.

Frank C. Garbutt died on June 13 at his home in Los Angeles. He was born near Toronto, Canada, in 1837, but came to the United States when 16 years old. He worked his way through Harvard, and served with the Union Army during the Civil War. In 1871 he went to Colorado where he practised his profession as a mining engineer. He erected a number of metallurgical plants including the reduction works at Salina; the Wyndam smelter, near Ouray; the Elgin smelter at Leadville; and the Redcliffe plant at Battle Mountain. The Garbutt mine is credited with the production of several millions. At the age of 80 he was still engaged actively in mining ventures in the South-West and in Mexico. He was a prominent and respected figure in the business and social life of Los Angeles.



ARIZONA

Globe.—The mill of the Iron Cap Copper Co. started on the morning of June 8. While it is now running half capacity the remaining unit will be put in operation shortly.

Inspiration will commence to sink two winzes from the 600-ft. level to the bottom of the orebodies for the purpose of exploring the lower levels of the ore, and also to open up a deeper haulage-level.

Humboldt.—The De Sota and Blue Bell mines of the Consolidated Arizona Smelting Co. shipped to the mills and smelter during the month of May 11,600 tons of ore. Of this tonnage the concentrator handled 7700 tons and the smelter treated 9000 tons. There was shipped to the refineries 1,250,000 lb. of copper, a little less than half of which was from company ores. The mill and smelter handled considerably more ore than during the past several months.

Jerome.—The Jerome Superior Copper Co. is to change its present oil-burning equipment for electrical machinery. The shaft, which is at present 840 ft. deep, is to be sunk to the 1500-ft. level. Pumps will be installed at the 1000 and 1500-ft. levels. The diamond-drilling which was being done on the 700-ft. level has been discontinued because of difficulties due to fractured ground. A splendid showing of shipping ore has been opened by a shallow shaft on the Jerome Central. Arrangements are under way for the financing of the Jerome Central. This property is south of the Smith group and the adjoining Black Hills patented claims 1½ miles south of Jerome.

CALIFORNIA

Nevada County.—Considerable interest attaches to the finding of high-grade silver ore in the Alcalde mine. The silver is found in a small shoot, accompanied by gold, and marks a rare occurrence in the Grass Valley district. Development of the main gold vein continues satisfactory, and the product going to the mill is said to be netting substantial profits.

Placer County.—The Nevada Pacific Exploration Co. has completed a test-run of its new 60-ton mill near Forest Hill and will make the initial clean-up before the end of June. The mill is stated to be operating satisfactorily and is apparently a success in all ways. Two prominent veins have been opened and sufficient ore is in sight to ensure steady production for two years. The company is also developing the Josephine group, in El Dorado county. The lower cross-cut has entered a small shoot of ore about 100 ft. in advance of the point where the vein was anticipated. The Josephine is credited with an output of \$550,000 from the old workings.

San Benito County.—The main plant of the New Idria Quicksilver Mining Co. was destroyed by fire on June 20. This company is the largest producer of quicksilver in the United States and probably in the world. Approximately 250 men will be out of work pending the reconstruction. Defective wiring is assigned as the cause of the fire. A large oil-tank was ignited and exploded, flooding the tramway terminal with the blazing fluid. The ore-crushing plant, warehouse, blacksmith-shop, furnaces, and several miners'

cabins also were destroyed. The loss is estimated at more than \$100,000.

Shasta County.—Preliminary work has begun at the Bully Hill mines, in which D. C. Jackling and associates have recently acquired an interest. Tunnels and shafts are being cleared, improvements made to the railroad, and the old smelter-site cleaned up. The site for the new \$1,000,000 smelter has been chosen across the ravine from the present smelter and north of the old plant. It is understood at Redding that within ninety days several hundred men will be put to work on the building and development planned. The group of claims has been developed to an approximate depth of 1000 ft. and is one of the richest copper-zinc mines in California.

Tuolumne County.—Seventy stamps are dropping at the Shawmut mill, and concentrate is being converted into bullion at the new refinery. The mine is working with a full crew and little difficulty has been experienced by the management in retaining its labor. This is said to be due to the excellent living accommodations provided by the company. Ore developments on the deeper levels continues satisfactory. The Shawmut is controlled by the Belmont Development Co. of Tonopah, and ranks high among the foremost producers on the Mother Lode.

COLORADO

Saguache County.—The Utah Leasing Co., a subsidiary of the Western Metals Co. of Salt Lake City, has taken over the Rawley properties near Bonanza, and will operate mines on a considerable scale. A 700-ton concentrator erected at Midvale, Utah, is being dismantled and shipped to Shirley, where it will be connected with the mines by a 7-mile tramway. The mines are developed by a 6000-ft. tunnel with a 1200-ft. raise to the surface and with numerous levels and drifts, which disclose large bodies of silver, gold, and copper ore. It is estimated that upward of \$250,000 will be spent in construction, equipment, and development and that the greater part of the year will be required to place the plant in operation.

IDAHO

Bonner County.—Re-opening of gold claims near Hope is being undertaken by the Auxer Gold Mines Co. of Hope, recently incorporated with a capitalization of \$500,000. It will work seven gold and silver claims. Considerable work has been done in the mine in recent years, including a 250-ft. tunnel and a 90-ft. shaft, with three drifts and several cross-cuts. Work is expected to start by July 1.

Coeur d'Alene.—The Cedar Creek Mining & Development Co. is advancing a drift on a vein found some time ago. The orebody is 26 ft. wide. Exploratory work done recently about 150 ft. from the face is reported to have revealed ore 35 ft. wide.

The Majestic Mining Co., whose mine is 1½ miles north-east of Burke, is starting a tunnel to cut at great depth the two veins opened on the main tunnel level. A winze will be sunk for a short distance on the vein in the main tunnel.

The Giant Ledge Mining Co. has opened ore for a long distance on the 400-ft. level of its main-shaft workings and men have been sent to the property to continue construction of the mill. Ore has been followed for 1400 feet.

THE METAL MARKET



METAL PRICES

San Francisco, June 22

Aluminum-dust, cents per pound.....	65
Antimony, cents per pound.....	10
Copper, electrolytic, cents per pound.....	19
Lead, pig, cents per pound.....	8.25-9.25
Platinum, pure, per ounce.....	\$85
Platinum, 10% iridium, per ounce.....	\$118
Quicksilver, per flask of 75 lb.....	\$85
Spelter, cents per pound.....	9.50
Zinc-dust, cents per pound.....	12.50-15.00

EASTERN METAL MARKET

(By wire from New York)

June 21.—Copper is inactive but steady. Lead is quiet and lower. Zinc is dull and easier.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid \$1 per ounce for all silver purchased by it, fixing a maximum of \$1.01½ on August 15, 1918, and will continue to pay \$1 until the quantity specified under the Act is purchased, probably extending over several years. On May 6, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
June 15.....	82.00	44.00	May 10.....	105.50	62.39
" 16.....	80.00	44.37	" 17.....	101.21	58.50
" 17.....	90.00	49.12	" 24.....	100.12	58.52
" 18.....	89.00	49.12	" 31.....	101.17	58.87
" 19.....	90.15	50.62	June 7.....	98.23	56.52
" 20 Sunday.....			" 14.....	86.00	48.02
" 21.....	90.25	51.50	" 21.....	87.07	48.73

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	88.72	101.12	132.77	July.....	99.62	106.38	....
Feb.....	85.79	101.12	131.27	Aug.....	100.31	111.35	....
Mch.....	88.11	101.12	125.70	Sept.....	101.12	113.92	....
Apr.....	95.35	101.12	118.56	Oct.....	101.12	119.10	....
May.....	99.50	107.23	102.69	Nov.....	101.12	127.57	....
June.....	99.50	110.50	....	Dec.....	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
June 15.....	19.00
" 16.....	19.00
" 17.....	19.00
" 18.....	19.00
" 19.....	19.00
" 20 Sunday.....	19.00
" 21.....	19.00

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	23.50	20.43	19.25	July.....	26.00	20.82	....
Feb.....	23.50	17.34	19.05	Aug.....	26.00	22.51	....
Mch.....	23.50	15.05	18.49	Sept.....	26.00	22.10	....
Apr.....	23.50	15.23	19.23	Oct.....	26.00	21.66	....
May.....	23.50	15.91	19.05	Nov.....	26.00	20.45	....
June.....	23.50	17.53	....	Dec.....	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
June 15.....	8.75
" 16.....	8.50
" 17.....	8.00
" 18.....	8.00
" 19.....	8.00
" 20 Sunday.....	8.00
" 21.....	8.00

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	6.85	5.60	8.65	July.....	8.03	5.53	....
Feb.....	7.07	5.13	8.88	Aug.....	8.05	5.78	....
Mch.....	7.26	5.24	9.22	Sept.....	8.05	6.02	....
Apr.....	6.99	5.05	8.78	Oct.....	8.05	6.40	....
May.....	6.88	5.04	8.55	Nov.....	8.05	6.76	....
June.....	7.59	5.32	....	Dec.....	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	85.13	71.50	62.74	July.....	93.00	70.12	....
Feb.....	85.00	72.44	59.87	Aug.....	91.33	62.20	....
Mch.....	85.00	72.50	61.92	Sept.....	80.40	55.79	....
Apr.....	88.53	72.50	62.12	Oct.....	78.82	54.82	....
May.....	100.01	72.50	54.99	Nov.....	73.67	54.17	....
June.....	91.00	71.83	....	Dec.....	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
June 15.....	7.90
" 16.....	7.85
" 17.....	7.85
" 18.....	7.70
" 19.....	7.70
" 20 Sunday.....	7.75
" 21.....	7.75

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	7.78	7.44	9.50	July.....	8.72	7.78	....
Feb.....	7.97	8.71	9.15	Aug.....	8.78	7.81	....
Mch.....	7.67	6.53	8.93	Sept.....	9.58	7.57	....
Apr.....	7.04	6.49	8.76	Oct.....	9.11	7.82	....
May.....	7.92	6.43	8.07	Nov.....	8.75	8.12	....
June.....	7.92	6.91	....	Dec.....	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	1918	1919	1920	July	1918	1919	1920
June 25.....	80.00	80.00	80.00	July.....	80.00	80.00	80.00
June 1.....	80.00	80.00	80.00	" 15.....	80.00	80.00	80.00
" 22.....	80.00	80.00	80.00	" 22.....	80.00	80.00	80.00

Monthly averages

Date	1918	1919	1920	July	1918	1919	1920
Jan.....	128.08	103.75	89.00	July.....	120.00	100.00	....
Feb.....	118.00	90.00	81.00	Aug.....	120.00	103.00	....
Mch.....	112.00	72.80	87.00	Sept.....	120.00	102.80	....
Apr.....	115.00	73.12	100.00	Oct.....	120.00	88.00	....
May.....	110.00	84.80	87.00	Nov.....	120.00	78.00	....
June.....	112.00	94.40	....	Dec.....	115.00	95.00	....

FRENCH TO BUY COPPER IN UNITED STATES

It is reported that French consumers have contracted to purchase 75,000 tons or 168,000,000 lb. of copper. This is the biggest individual sale for export since 1918, and involves approximately \$32,000,000, based on present market prices. The Copper Export Association will handle the business for American producers. French consumers will take approximately 3000 tons or 6,720,000 lb. monthly for two years to come. A new contract calls for payment of current market prices at the time of shipment. Buyers are given 90-day credits, with option of exercising three 90-day renewals. In other words, French consumers have a year from the time of shipment in which to pay for the copper. Copper authorities expect that other foreign consumers will enter the market now that French buyers have contracted to take this big block of metal, and it is predicted the price of copper will advance steadily due to the fact that producers are curtailing output due to labor shortage and poor transportation facilities. The existing dullness in the domestic market is accounted for by the heavy buying in March, which met the requirements of consumers for some time in advance.

THE SILVER MARKET ABROAD

Samuel Montagu & Co., in a recent market letter, says:

"The rally last week in exchange in China proved to be but temporary; support from that quarter has only been at falling rates and even then somewhat reluctant in character. As India is still refraining from purchases, the market does not possess much animation—a state of affairs not improved by sales from America, where the quotation has dipped below one dollar per ounce. Even if fresh American-produced supplies (say 80,000,000 per annum) are absorbed by the U. S. Mint, the outlook for silver is not good for melted coin for realization is arriving and likely to arrive from the Continent in substantial quantities; that is to say, the Continent, which was a continual buyer of considerable amounts before the War, is now a seller on balance to a very appreciable extent. The drastic requirements of the U. S. Mint for certificates as to the U. S. origin and refining of the bars, may cause a good deal of metal, though actually suitable, to be excluded from purchase because the owners cannot definitely verify the contents.

"In view of the great absorption of silver in India and the small production in that country (given by the Director of the U. S. Mint as 270,000 oz. in 1915), the recent discovery of a silver lode near the Tata Iron & Steel Co.'s works in Bengal is of interest. The vein is seven feet thick and has been uncovered to a length of 1000 ft. and a depth of 70 ft. The assay averages 200 oz. of silver per ton together with some gold. The first bars from the mine were expected in Calcutta at the end of last month. The 'Times' of India states that the presence of silver and gold in the transition rocks of South Bihar and Bengal has long been recognized, but hitherto these metals have not been found in this region in remunerative quantities."

MONEY AND EXCHANGE

Foreign quotations on June 22 are as follows:

Sterling, dollars:	Cable	4.00
	Demand	4.75
Francs, cents:	Cable	8.40
	Demand	8.43
Lire, cents:	Demand	6.28
Marks, cents		2.85

Eastern Metal Market

New York, June 16.

All the markets are quite generally inactive and show few signs of an early resumption of buying.

Demand for copper is very light but producers' prices are firm.

The tin market is declining and consumers are disinclined to enter.

An easier tendency in lead is apparent and there is no disposition to buy.

There is no change in demand or prices for zinc. Both are fairly steady.

Antimony is lower because of the decline in silver.

IRON AND STEEL

Steel production keeps up at a higher rate than the very moderate betterment in car-movement would indicate. It is to be expected that the gorge of finished material at various mills will be broken as the railroads keep working on it, but for many weeks coal and coke supply will be the key to the whole iron and steel situation. In the past week hot weather and the breaking-in of so many new railroad workers have shown that a trying summer is ahead.

The May output of steel ingots, partly estimated, was about 3,430,000 tons, a gain of 10% over April, and the industry was surprised that the total for the past five months was at a yearly rate of 41,400,000 tons, pointing to the possibility that 1920 may yet be one of the three great years in steel. Consumers who are wrestling with the most difficult situation in all their experience are still puzzled by the large production and the smallness of the visible supply of finished steel of nearly all descriptions.

COPPER

A diagnosis of the present situation in copper based on the opinion of a representative of a leading producer is about as follows: The heavy buying in March covered the needs of most consumers through June and in some cases into July. In April and May the railroad and labor troubles interfered decidedly with consumption, shipment, and also with production, thus pushing ahead supplies ultimately expected to be consumed by the end of June. The buying-movement which normally would have been expected this month has therefore been put forward two or more months. Also there is no cause for active purchasing now by large consumers at least. The market is therefore quite inactive and devoid of interest. Leading producers, however, continue to maintain their prices firmly at 19c., New York, for June-July delivery and see no reason to change them. From dealers and other sources some small lots are obtainable at anywhere from 18.25 to 18.75c., New York.

TIN

This market has fallen to new low levels on this movement, spot Straits having touched 46.50c., New York, on June 10 and 14, and 45.50c. yesterday. The market has been quiet and dull with consumers, while showing some interest, apparently afraid to make purchases and discouraged because of the general industrial situation. They appear to have, however, supplies for several months longer. On Monday, June 14, quotations were largely nominal with all positions ruling at 46.50c., London having been higher on that day, but New York lower, due to the decline in silver. Yesterday there was a further slump in London with spot Straits quoted at £260 per ton, a decline of £20 per ton since a week ago. The New York spot Straits quotation yesterday was also lower, 45.50c. Sales during the week were light, aggregating not over 300 tons at price-ranges of 46.25c. to

48.37½c. for future shipments. Chinese No. 1 tin sold at 43c. for April, May, and June shipment. Arrivals thus far this month have been 1915 tons with the quantity afloat at 4645 tons.

LEAD

Consumers are entirely indifferent and do not desire to buy. There is now no difficulty in buying spot lead, New York, at 9c. and it can be had under this level or at about 8.87½c., although it is not generally so offered. Lead in transit is also obtainable at 8.87½c., New York. The movement of the metal is much freer but consumers have no faith in present prices. As a result the market is dull, stale, and stagnant. One interest yesterday expressed the opinion that lead might fall to 7c. in the next two or three months. For delivery in 30 days we quote the market unchanged at 8.50c., St. Louis, or 8.75c., New York.

ZINC

This market continues in its lifeless condition. Under the circumstances prices are fairly steady. Prime Western is quoted at 7.55c., St. Louis, or 7.90c., New York, for delivery into the third quarter, but little buying is reported. Large producers are supplying only the needs of regular customers at prevailing quotations which are made largely by dealers and traders. One prediction is that zinc will fall to 7c., St. Louis, before the trend reverses and it goes higher.

ANTIMONY

The recent decline of many points in silver has affected this market which is lower at 7.75c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, for early delivery are quoted at 33c., New York, by the leading interest and at 31.50c. by other sellers.

ORES

Tungsten: The market is still inactive with no trend one way or the other. Prices are nominal.

Ferro-tungsten is unchanged at 85c. to \$1.15 per lb. of contained tungsten.

Molybdenum: This market is also featureless and dead with quotations nominal at 75c. per lb. of MoS₂ in regular concentrate.

Manganese: Prices are firm at 80c. to \$1 per unit but offerings are light. Demand is excellent and sales could easily be made because the number of producers of ferro-manganese is increasing, both blast-furnace and electric furnace. Recent transactions indicate that the imports of Indian manganese ore to this country will increase considerably in the second half of the year. The first manganese from the Caucasus since 1914 recently reached England at a price close to £12 per ton.

Manganese-Iron Alloys: There is a surprising lack of inquiry for ferro-manganese for either spot or last-half deliveries. If consumers are waiting for lower prices they are likely to be disappointed in the opinion of many in the trade. Prices are unchanged at \$225 to \$250, delivered, for June and \$200 for last half. Production in May was 22,663 gross tons, according to revised statistics of 'The Iron Age'. This is the largest output for any month this year, the April production having been 21,028 tons. The spiegeleisen market is quiet and strong at \$75, furnace, with only small lots reported sold. The output in May was 10,744 tons, which compares with 15,472 tons in March.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

THE USE OF WOOD PIPE

Wood pipe is recommended for a wide variety of purposes under greatly varying conditions. There are, however, certain restrictions placed on its use which are recognized by the wood-pipe manufacturers. They are making a strenuous effort to encourage the use of their products in those instances where its suitability has been demonstrated and just as strenuous an effort to discourage its use for those purposes and under those conditions where its unsuitability has been proved. The reason that they take this position is obvious—the greatest development of any industry depends primarily on the intelligent use of the product manu-

lished by the U. S. Department of Agriculture and reported in Bulletin No. 376 by Fred C. Scobey. In 1916, Mr. Scobey made a series of sixty-four tests in sixteen separate pipe-lines, and from the results of these tests, together with the reports of many prominent investigators on this subject, has published a formula for the flow of water in wood pipe and also tables showing the capacity of different sizes of pipe. As a result of Mr. Scobey's investigations, his conclusion is, "that wood pipe will convey about 15% more water than a 10-year old cast-iron pipe or a new riveted pipe, and about 25% more than a cast-iron pipe 20 years old or a riveted pipe 10 years old".

While low cost and high efficiency and greater capacity are often determining factors, adaptability many times has led to the use of wood pipe regardless of other factors. A large proportion of the existing water-supply pipe-lines in use today traverse remote and inaccessible districts. The transportation of materials of construction to the line of work and the assembling of same into a complete pipe-line has proved a problem most easily solved by the use of wood pipe. The smaller sizes of wood pipe are easily transported, being light in weight and of convenient length. The larger sizes of wood pipe are shipped in the 'knocked down' and assembled in place into a complete pipe-line. The length of staves and number of bands or



Twelve-Foot Wood Pipe-Line at Trenton Falls, N. Y.

factured. With this idea in mind the advantages of wood pipe may be pointed out with exceptional clarity.

The primary purpose of a pipe-line is to deliver water or other liquids from one point to another, this operation to be continued for a certain length of time or more likely for an indefinitely long period. The low initial cost of wood pipe, the low maintenance cost, and the saving effected in interest charges by reason of low initial investment, make it the most economical pipe that can be installed regardless of the period of service required. The efficiency of any pipe-line is relative; that is, it may serve the purpose for which it is intended better or worse than a line constructed of other materials. Wood pipe, by reason of its smooth internal surface and its freedom from corrosion, tuberculation, or other action tending to reduce this original smoothness, is unquestionably the most efficient pipe yet produced.

Efficiency and capacity are so closely related that a reference to one naturally suggests the other. That under the same conditions, wood pipe will convey more water than the same diameter pipe made of other materials, which are at times considered as substitutes, has been definitely estab-

lished by the U. S. Department of Agriculture and reported in Bulletin No. 376 by Fred C. Scobey. In 1916, Mr. Scobey made a series of sixty-four tests in sixteen separate pipe-lines, and from the results of these tests, together with the reports of many prominent investigators on this subject, has published a formula for the flow of water in wood pipe and also tables showing the capacity of different sizes of pipe. As a result of Mr. Scobey's investigations, his conclusion is, "that wood pipe will convey about 15% more water than a 10-year old cast-iron pipe or a new riveted pipe, and about 25% more than a cast-iron pipe 20 years old or a riveted pipe 10 years old".

While low cost and high efficiency and greater capacity are often determining factors, adaptability many times has led to the use of wood pipe regardless of other factors. A large proportion of the existing water-supply pipe-lines in use today traverse remote and inaccessible districts. The transportation of materials of construction to the line of work and the assembling of same into a complete pipe-line has proved a problem most easily solved by the use of wood pipe. The smaller sizes of wood pipe are easily transported, being light in weight and of convenient length. The larger sizes of wood pipe are shipped in the 'knocked down' and assembled in place into a complete pipe-line. The length of staves and number of bands or shoes per bundle can be accommodated to the means of transportation without interfering with the work of assembling or without reducing the efficiency of the completed pipe. Pipe as large as 14 ft. inside diameter is constructed of staves measuring approximately 4 by 6 in. in cross-section and of any desired length up to 40 ft. Consequently the construction of the largest pipe required offers no insurmountable difficulties to the wood-pipe manufacturers' experts and their experienced crews. Under adaptability may be mentioned also the fact that wood pipe is admirably suited for the construction of pipe-lines traversing country of uneven contour. Bends or sharp curves, if required, can be 'built into the line' by the experienced crews. It is possible to construct readily continuous-stave wood pipe-lines, winding up and down hill or around a bend as required. It is not possible for any other material to lend itself so readily to the installation of pipe-lines of this sort without excessive construction and assembling costs. Wood pipe is manufactured in three different types: wire-wound, continuous stave, and bored. Each type is made especially to serve a specific demand. The accompanying photograph shows a 12-ft.

wood pipe-line at Trenton Falls, New York. Among the mining companies that have wood pipe-lines are: Utah Copper Co., Arthur, Utah; Chino Copper Co., Hurley, New Mexico; Alaska Gastineau Mining Co., Juneau, Alaska; Anaconda Copper Mining Co., Anaconda, Montana; Burro Mountain Copper Co., Tyrone, New Mexico; Cerro de Pasco Mining Co., Peru; Gebroeders Veth, Pandang, Sumatra; British Columbia Copper Co., Greenwood, B. C.; Caribou Mines Co., Soda Springs, Idaho; American Smelting & Refining Co., Garfield, Utah; Braden Copper Co., Chile; Morococha Mining Co., Peru; Placerville Gold Mining Co., Placerville, California; Nevada Consolidated Copper Co., McGill, Nevada; Ray Consolidated Copper Co., Hayden, Arizona; Phelps Dodge Co., Bisbee, Arizona; United Comstock Pumping Association, Virginia City, Nevada.

PULMORE PULLEY TREAD

Almost every user or operator of belt-driven machinery has experienced—sometimes more frequently than desirable—excessive belt-slip or unusual wear due to a greater loading than that for which either the belt or pulleys were intended. Sometimes the loading may be due to a need for greater production beyond anything the belt or pulleys were designed and built to deliver—or to a lack of definite knowledge at the start just what the loading would be. There are various temporary or inadequate and harmful remedies for these conditions, such as excessive belt tension to eliminate slip, but with the resultant shorter life of the belt; or belt-dressings which may materially reduce the length of service a good belt should give.

Two permanent cures for excessive slip or overloading are larger pulleys and belts, or a pulley having friction surface equal to that of the belt. Pulmore pulley tread is a chemically treated fibre compressed into sheet form and it is easily applied to any kind of pulley simply by soaking in water for a few seconds to loosen up the chemical compound. When dry, it sticks to the pulley face and gives it a frictional tread equivalent to leather. Pulmore pulley tread gives this greater capacity equally well when used to cover iron, steel, wood, paper, or other pulleys used in connection with leather or other comparatively smooth-surfaced belts.

The difference in tractive friction is very apparent and is easily observed by one's sense of feeling in the case of an iron pulley, most of which is covered with the tread. In operation the uncovered part becomes polished and 'slippery' due to the constant creep or slip of the belt on the iron, while the treaded part presents a much more resistant surface alike to one's hand or fingers and to the belt. These then are the uses for Pulmore pulley tread:

1. By increased tractive friction obtained, to increase production with the same pulleys and belt.
2. To decrease belt-tension so that belts will last longer even when the same or greater power is transmitted.
3. To reduce frictional losses in bearings caused by excessive belt tension.
4. To lower first cost of pulleys, belts, and shafting by using smaller sizes.
5. To build up the crowning of worn pulleys or others needing a greater crown.
6. To eliminate troubles due to belts coming off because of excessive slip.

Bulletin No. 201, issued by Smith & Serrell, Newark, New Jersey, gives details of the merits, and directions for using Pulmore pulley tread.

The American Manganese Steel Co. announces that Walter Brinton, who was manager of its plant at New Castle, Delaware, for several years, has been elected vice-president of the company.

COMMERCIAL PARAGRAPHS

The Ingersoll-Rand Co. and the A. S. Cameron Steam Pump Works announce a change in their Chicago address. The new offices will be situated at 709 Fisher Building.

Girard B. Rosenblatt, electrical engineer specializing in the mining and metallurgical field, with the Westinghouse Electric & Manufacturing Co., has moved his office to 521 First National Bank Bldg., San Francisco.

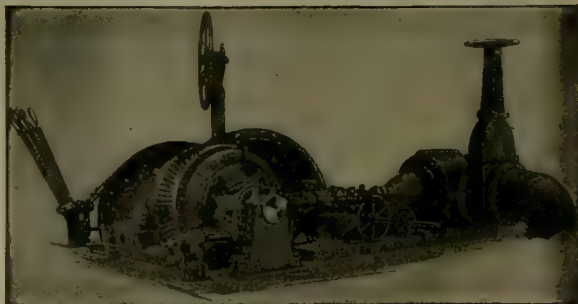
The Worthington Pump & Machinery Corporation has issued an interesting announcement of its success in making a new Worthington marine oil-engine of 2400 indicated horse-power. The present engine is of Diesel type, has six cylinders, 29-in. bore, 46-in. stroke, and a speed of 120 r.p.m. Other sizes are planned.

The Southwestern Engineering Co. reports the following movements of members of its staff: Max Kraut is at the Arizona Middlemarch mine near Pearce, Arizona; E. J. Atckison is doing consulting work at the Argonaut tailing mill near Jackson, California; and L. C. Penhoel is at Nevada City, California.

The Gandy Belting Co. announces the appointment of Fielder I. Schillinger Jr. to the position of general sales manager, succeeding Chas. H. Dankmeyer, resigned. The recently opened Chicago branch at 549 West Washington St. will be under the charge of H. Milton Michel, who comes from the New York branch. Robert Crane will be in charge of the New York branch at 36 Warren street.

Rosenburg & Co. of Los Angeles announces the opening of a new warehouse at Phoenix, Arizona. A lease has been taken for the large building at 420 East Jefferson St., and it is the intention of the company to display a large stock of machinery immediately. This is the third warehouse opened by Rosenburg & Co. Eighteen months ago a warehouse was established at Congress Junction, Arizona. The new warehouse at Phoenix which opened July 1 will carry a \$500,000 stock of mining and milling machinery and equipment and in addition will house a large quantity of electrical goods. The Allingham flotation machine manufactured by Rosenburg & Co. will also be represented at the new Phoenix warehouse.

The accompanying illustration shows a water-driven hoist specially built for the South American Development Co. of Portovelo, Ecuador, by the Wellman-Seaver-Morgan Co. of



Water-Driven Mine Hoist

Cleveland, Ohio. As neither electricity nor steam was available the hoist was made to be operated by a W-S-M water-turbine. The present drive consists of one reduction by bevel-gearing, one reduction by spur-gearing, and one by herringbone gears, the turbine running continuously in one direction. The hoist is fitted with dial-indicator, two brake-bands and bevel-gear clutches. A feature of the design is the sectional construction. The maximum cordilleran pack-load is 300 lb. and the entire machine was transported by mule-back from Santa Rosa to the mine.





